Modbus for Level Control 2X1
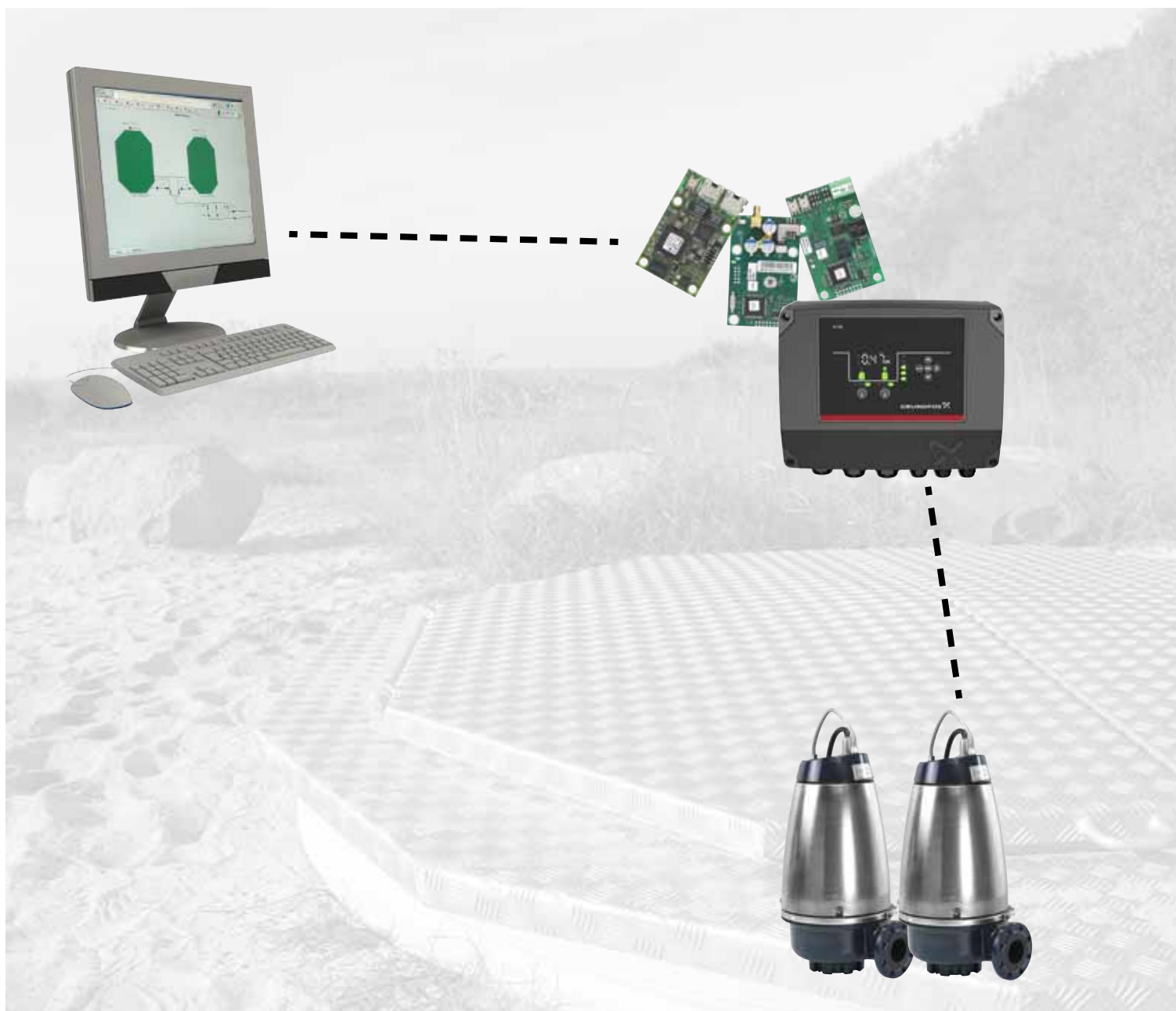
CIM 200 Modbus RTU
CIM 250 GSM/GPRS
CIM 500 Ethernet for Modbus TCP

Functional profile and user manual

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GRUNDFOS

English (GB) Functional profile and user manual

Original functional profile and user manual.
This functional profile describes Grundfos Modbus for Level Control 2X1.

CONTENTS

1. General information

1.1 Hazard statements

The symbols and hazard statements below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

DANGER
Indicates a hazardous situation which, if not avoided, will result in death or serious personal injury.

WARNING
Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.

CAUTION
Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

The hazard statements are structured in the following way:

SIGNAL WORD
Description of hazard
Consequence of ignoring the warning.
- Action to avoid the hazard.

1.2 Notes

The symbols and notes below may appear in Grundfos installation and operating instructions, safety instructions and service instructions.

Observe these instructions for explosion-proof products.

A blue or grey circle with a white graphical symbol indicates that an action must be taken.

A red or grey circle with a diagonal bar, possibly with a black graphical symbol, indicates that an action must not be taken or must be stopped.

If these instructions are not observed, it may result in malfunction or damage to the equipment.

Tips and advice that make the work easier.

2. Introduction

2.1 About this functional profile

This functional profile describes the following modules and units:
- CIM 200 Modbus RTU
- CIM 250 Modbus GSM/GPRS
- CIM 500 Modbus ethernet for Modbus TCP

This functional profile applies to the following Grundfos products:
- Grundfos level-control system LC 231
- Grundfos level-control system LC 241.

In the following, the two supported controllers are referred to as LC 2X1.

Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming of Modbus devices. The reader should also have some basic knowledge of the Modbus protocol and technical specifications.

It is also assumed that an existing Modbus network with a Modbus master is present.

2.3 Definitions and abbreviations

0b	Prefix for binary number.
0x	Prefix for hexadecimal number.
3G	Third-generation mobile telephony network.
4G	Fourth-generation mobile telephony network.
APN	Access Point Name.
ARP	Address Resolution Protocol. Translates IP addresses into MAC addresses.
Auto-MDIX	Ensures that both crossover cable types and non-crossover cable types can be used.
CAT5	Ethernet cable type with four twisted pairs of wires.
CAT5e	Enhanced CAT5 cable with better performance.
CAT6	Ethernet cable compatible with CAT5 and CAT5e and with very high performance.
CIM	Communication Interface Module.
CIU	Communication Interface Unit.
CRC	Cyclic Redundancy Check. A data error detection method.
CSD	Circuit Switched Data. Connection is established via a fixed connection that is a physical circuit or a reserved data channel.
DHCP	Dynamic Host Configuration Protocol. Used to configure network devices so that they can communicate on an IP network.
DNS	Domain Name System. Used to resolve host names to IP addresses.
GENIbus	Proprietary Grundfos fieldbus standard.
GENIpro	Proprietary Grundfos fieldbus protocol.
GPRS	General Packet Radio Service. Technology for TCP/IP communication and internet access via GSM.
GRE	Generic Routing Encapsulation
Grundfos GO	A Grundfos application designed to control Grundfos products via infrared or radio communication. Available for iOS and Android devices.
GSM	Global System for Mobile communications.
H	Head (pressure).
HMI	Human Machine Interface.
HTTP	Hyper Text Transfer Protocol. The protocol commonly used to navigate the world wide web.
IANA	Internet Assigned Numbers Authority.

IP	Internet Protocol.
LC 231	Grundfos wastewater level-controller for one or two pumps also supporting some basic IO signals. It is a box for wall mounting.
LC 241	Grundfos wastewater level-control system. Consists of a control cabinet with the CU 241 control unit, IO 242 pump module for connection of one or two pumps and some basic IO signals and an optional IO 241 module for extra IO signals.
LED	Light-Emitting Diode.
MAC	Media Access Control. Unique network address for a piece of hardware.
Modbus	A serial communications protocol commonly used in industry and building automation systems.
Modbus RTU	Modbus is a fieldbus used worldwide. The RTU version is used for wired networks, CIM 200 and for call-up connections over telephone networks, CIM 250.
Modbus TCP	Modbus is a fieldbus used worldwide. The TCP version is adapted for use as an application protocol on TCP/IP using either GPRS for CIM 250 or ethernet for CIM 500 as basis.
PIN	Personal Identification Number. For SIM cards.
Ping	Packet InterNet Groper. A software utility that tests the connectivity between two TCP/IP hosts.
PUK	Personal Unblocking Key. For SIM cards.
RTU	Remote Terminal Unit.
SELV	Separated or Safety Extra-Low Voltage.
SELV-E	Separated or Safety Extra-Low Voltage with earth connection.
SIM	Subscriber Identity Module. SIM card.
SMA	SubMiniature version A. Coaxial radio signal cable connection standard.
SMTP	Simple Mail Transfer Protocol.
SNTP	Simple Network Time Protocol. Used for clocks synchronisation between computer systems.
TCP	Transmission Control Protocol. Protocol for internet communication and Industrial Ethernet communication.
TCP/IP	Transmission Control Protocol/Internet Protocol. Protocol for internet communication.
Transmission speed	Bits transferred per second, bits/s.
URL	Uniform Resource Locator. The IP address used to connect to a server.
UTC	Coordinated Universal Time. The primary time standard by which the world regulates clocks and time.
UTF-8	Unicode Transformation Format. Character encoding.
VPN	Virtual Private Network. A network using the internet to connect nodes. These systems use encryption and other security mechanisms to ensure that only authorised users can access the network and that the data cannot be intercepted.

3. System description

3.1 Modbus

Grundfos level control LC 2X1 is connected to one or two Grundfos wastewater pumps. It offers status information as well as control and monitoring of a wastewater pit via a user-friendly control panel with display.

3.2 Modbus RTU, CIM 200

CIM 200 is an add-on communication module that you fit in LC 2X1, using a 10-pin connection. This enables communication with a PLC, SCADA system, etc.

Via the Modbus RTU connection, it is possible to control the system and read status, measured values, logs, etc.

Fig. 1   CIM 200 solution for LC 2X1. One or two pumps can be connected

3.3 Modbus GSM/GPRS, CIM 250

CIM 250 is an add-on communication module that you fit in LC 2X1, using a 10-pin connection. This enables GSM/GPRS communication with a PLC, SCADA system, mobile phone, etc.

Via the GSM/GPRS connection, it is possible to control the system and read status, measured values, logs, etc.
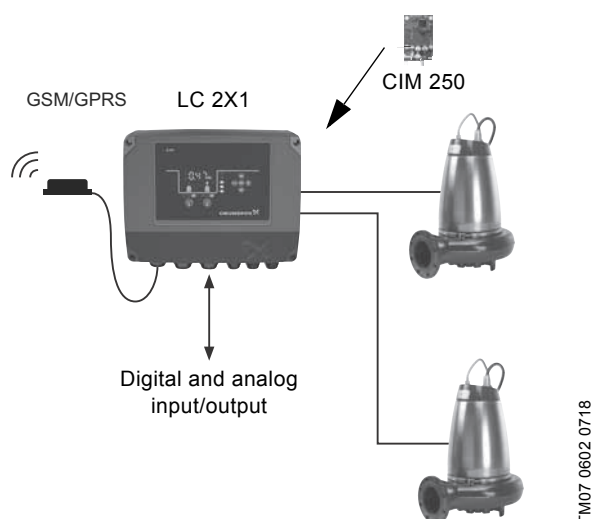
Fig. 2   CIM 250 solution for LC 2X1. One or two pumps can be connected

3.4 Modbus TCP, CIM 500

CIM 500 is an add-on communication module that you fit in LC 2X1, using a 10-pin connection. This enables communication with a PLC, SCADA system, etc.

Via the Modbus TCP connection, it is possible to control the system and read status, measured values, logs, etc.
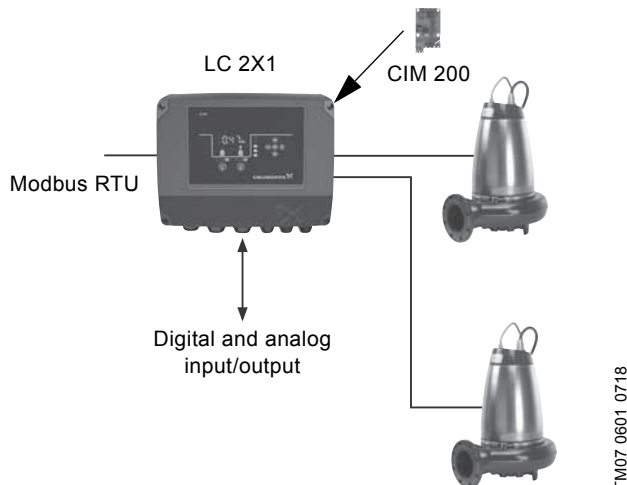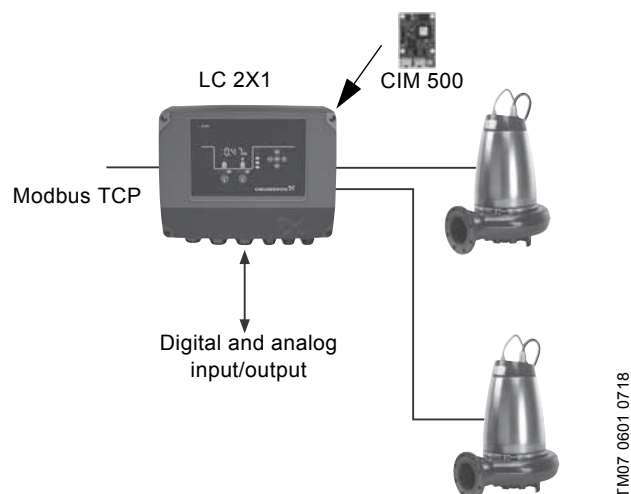

Fig. 3   CIM 500 solution for LC 2X1. One or two pumps can be connected

4. Specifications

4.1 CIM module

General data	Description	Comments
Ambient humidity	30-95 %	Relative, non-condensing.
Operating temperature	-20 to +45 °C	
Storage temperature	-25 to +70 °C	
Battery, lithium-ion	You can only charge the battery if the battery temperature is within 0 to 45 °C.	CIM 250 only.
GENIbus visual diagnostics	LED2	The LED will be in one of these states: Off, permanently green, flashing red, permanently red. See section 5.5 Status LEDs.

4.2 CIM 200 Modbus RTU

The table below provides an overview of the specifications for Grundfos CIM 200. For further details, refer to the specific sections of this functional profile.

Modbus RTU specifications	Description	Comments
Modbus connector	Screw-type terminal	3 pins. See section 5. Modbus RTU, CIM 200 setup.
Modbus connection type	RS-485, 2-wire + common	Conductors: D0, D1 and common. See section 5. Modbus RTU, CIM 200 setup.
Maximum cable length	1200 m	Equals 4000 ft.
Slave address	1-247	Set via rotary switches SW6 and SW7. See section 5.3 Modbus address selection.
Line termination	On or off	Set via DIP switches SW1 and SW2. See section 5.4 Termination resistor.
Recommended cable cross-section	0.20 - 0.25 mm^2	AWG24 or AWG23
Supported transmission speeds	1200*, 2400*, 4800*, 9600, 19200, 38400 bits/s	Set via DIP switches SW4 and SW5. See section 5.1 Setting the Modbus transmission speed.
Start bit	1	Fixed value.
Data bits	8	Fixed value.
Stop bits	1 or 2	Set via DIP switch SW3. See section 5.2 Setting the parity.
Parity bit	Even parity, odd parity* or no parity	Set via DIP switch SW3. See section 5.2 Setting the parity.
Modbus visual diagnostics	LED1	Off, flashing green, flashing red, permanently red. See section 5.5 Status LEDs.
Maximum number of Modbus devices	32	Using repeaters, you can increase this number. Legal address range is 1-247.
Maximum Modbus telegram size	256 bytes	Total length. Node address and CRC included. See section 12. Modbus function-code overview.

*   Can only be set via software.

4.3 CIM 250 GSM/GPRS

The table below provides an overview of the specifications for Grundfos CIM 250. For further details, refer to the specific sections of this functional profile.

Modbus GSM/GPRS specifications	Description	Comments
Data protocol	Modbus RTU/Modbus TCP	GSM call-up uses RTU. GPRS uses TCP.
Slave address	Factory 231 (0xE7)	You can change the address via Modbus register 00003, SoftwareDefinedModbusAddress.
GSM/GPRS visual diagnostics	LED1	See section 6.2 Status LEDs.
Maximum Modbus telegram size	260 bytes	Total Modbus TCP/IP application data unit. See fig. 19.

4.4 CIM 500 Modbus TCP

The table below provides an overview of the specifications for Grundfos CIM 500 for Modbus TCP. For further details, refer to the specific sections of this functional profile.

Modbus TCP specifications	Description	Comments
Application layer	DHCP, HTTP, Ping, FTP, SMTP, SNTP, Modbus TCP	Rotary switch in position 1.
Transport layer	TCP	
Internet layer	Internet protocol V4 (IPv4)	
Link layer	ARP, media access control (ethernet)	
Ethernet cable	CAT5, CAT5e or CAT6	Supports auto cable-crossover detecting (Auto-MDIX).
Maximum cable length	100 metres at 10/100 Mbits/s	Corresponds to 328 feet.
Transmission speed	10 Mbits/s, 100 Mbits/s	Auto-detected.
Industrial Ethernet protocols	PROFINET IO, Modbus TCP	Selected with rotary switch, section 7.2 Setting the Industrial Ethernet protocol.

5. Modbus RTU, CIM 200 setup

TM04 1697 0908
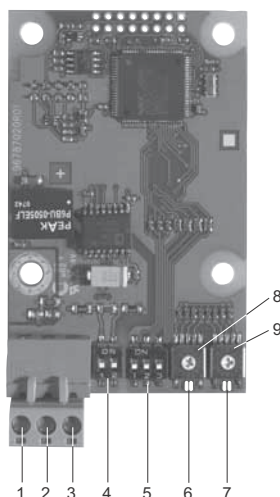
Fig. 4   CIM 200 Modbus module

Pos.	Designation	Description
1	D1	Modbus terminal D1, positive data signal
2	D0	Modbus terminal D0, negative data signal
3	Common/GND	Modbus terminal Common and GND
4	SW1/SW2	On and off switches for termination resistor
5	SW3/SW4/SW5	Switches for selection of Modbus parity and transmission speed
6	LED1	Red and green status LED for Modbus communication
7	LED2	Red and green status LED for internal communication between CIM 200 and the Grundfos product
8	SW6	Hexadecimal rotary switch for setting the Modbus address, four most significant bits
9	SW7	Hexadecimal rotary switch for setting the Modbus address, four least significant bits

Use a screened, twisted-pair cable. Connect the cable screen to protective earth at both ends.

Recommended connection

Modbus terminal	Colour code	Data signal
D1-TXD1	Yellow	Positive
D0-TXD0	Brown	Negative
Common/GND	Grey	Common/GND

5.1 Setting the Modbus transmission speed

Set the transmission speed correctly before CIM 200 is ready to communicate with the Modbus network. Use DIP switches SW4 and SW5 for setting the transmission speed. See fig. 5.

SW4 SW5

TM04 1710 0908
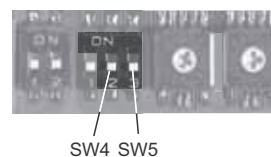
Fig. 5   Modbus transmission speed

DIP switch settings

Available transmission speeds in bits/s: 1200, 2400, 4800, 9600, 19200 and 38400.

The first three transmission speeds are only available via software settings, whereas the last three are available via DIP switches.

Transmission speed [bits/s]	SW4	SW5
9600	OFF	ON
19200	OFF	OFF
38400	ON	OFF
Software-defined	ON	ON

Default transmission speed is 19200 bits per second, as per the Modbus RTU standard.

Software-defined

When SW4 and SW5 are set to "software-defined", writing a value to the holding register at address 00004 will set a new transmission speed.

Use the following values for software-defined transmission speeds:

Software-defined transmission speed	Value to set in register 00004
1200 bits/s	0
2400 bits/s	1
4800 bits/s	2
9600 bits/s	3
19200 bits/s	4
38400 bits/s	5

This value is set to 1200 bits/s as default.

The communication interface does not support transmission speeds above 38400 bits/s.

The software-defined transmission speed value is stored in the communication interface and remains after a power-off.

5.2 Setting the parity

When software-defined transmission speed is enabled (ON), software-defined parity and stop bits are also enabled.

You can set the parity either manually by using SW3 or via software-defined settings.

Manual setting of parity

Default byte format (11 bits):
- 1 start bit
- 8 data bits, least significant bit sent first
- 1 parity bit, even parity
- 1 stop bit.

The default setting of the CIM 200 Modbus module is even parity, 1 stop bit. It is possible to change the parity using DIP switch SW3. You can change the parity to no parity, 2 stop bits. See fig. 6.
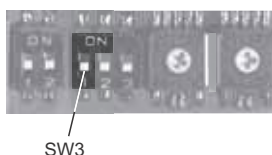
Fig. 6 Parity

DIP switch settings

Parity	SW3
Even parity, 1 stop bit	OFF
No parity, 2 stop bits	ON

Software-defined parity and stop bits

When SW4 and SW5 are set to "software-defined", the value in the holding registers at addresses 00009 and 00010 will override the setting of SW3. See figs 5 and 6.

Software-defined parity	Value to set in register 00009
No parity (default)	0
Even parity	1
Odd parity	2

Software-defined stop bit	Value to set in register 00010
1 stop bit (default)	1
2 stop bits	2

The software-defined parity and stop-bit values are stored in the communication interface and remains after a power-off.

Before you can set the parity and stop bits via software-defined settings, you must set SW4 and SW5 to ON.

5.3 Modbus address selection

A Modbus slave on a Modbus network must have a unique address from 1-247. Address 0 is reserved for broadcasting, and is not a valid slave address.

To set the Modbus address, use two hexadecimal rotary switches, SW6 and SW7. See fig. 7.

SW6   SW7
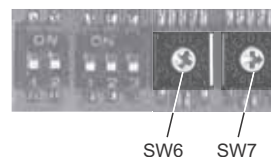
Fig. 7 Setting the Modbus address

For a complete overview of Modbus addresses, see section *15. Fault finding the product*.

You must set the Modbus address decimally from 1 to 247.

5.4 Termination resistor

The termination resistor is fitted on CIM 200 Modbus and has a value of 150 Ω.

CIM 200 has a DIP switch with two switches, SW1 and SW2, for cutting the termination resistor in and out. Figure 8 shows the DIP switches in cut-out state.
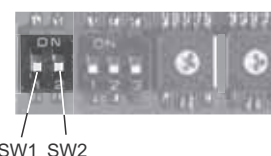
SW1 SW2

Fig. 8 Cutting the termination resistor in and out

DIP switch settings

Status	SW1	SW2
Cut in	ON	ON
Cut out	OFF	OFF
	ON	OFF
	OFF	ON

Default setting: Termination-resistor cut-out.

Cable length

We recommend the following maximum lengths:

Bits/s	Maximum cable length	
	Terminated cable	Unterminated cable
	[m/ft]	[m/ft]
1200-9600	1200/4000	1200/4000
19200	1200/4000	500/1700
38400	1200/4000	250/800

To ensure a stable and reliable communication, it is important that only the termination resistor of the first and last units in the Modbus network are cut in.

All switch settings will be effective immediately after setting the values. No power-off is needed.

5.5 Status LEDs

CIM 200 Modbus has two LEDs. See fig. 4.

• Red and green status LED, LED1, for Modbus communication
• Red and green status LED, LED2, for internal communication between CIM 200 and the Grundfos product.

LED1

Status	Description
Off	No Modbus communication.
Flashing green	Modbus communication active.
Flashing red	Fault in the Modbus communication.
Permanently red	Fault in CIM 200 Modbus configuration.

LED2

Status	Description
Off	CIM 200 has been switched off.
Flashing red	No internal communication between CIM 200 and the Grundfos product.
Permanently red	CIM 200 does not support the Grundfos product connected.
Permanently green	Internal communication between CIM 200 and the Grundfos product is OK.

During startup, there may be a delay of up to 5 seconds before LED2 status is updated.

6. Modbus GSM/GPRS, CIM 250 setup
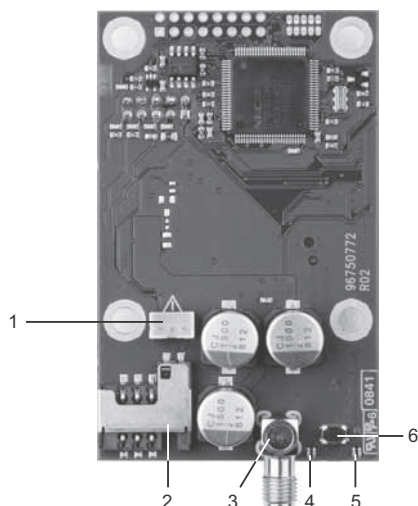
Fig. 9 CIM 250 GSM module, top-side view

Pos.	Designation	Description
1		Battery socket
2		SIM card holder
3		SMA connection for GSM antenna
4	LED1	Yellow and green status LED for GSM/GPRS communication
5	LED2	Red and green status LED for internal communication between CIM 250 and the Grundfos product.
6	SW1	Reset button. Keep the button pressed for 5 seconds to return to default settings.

6.1 Installation

DANGER

Electric shock

Death or serious personal injury
- Before starting any work on the product, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

6.1.1 Fitting a GSM antenna

Connect an antenna to CIM 250 to establish connection to the GSM network.

Grundfos offers different kinds of antennas. No antenna is supplied with CIM 250. You can order it separately.

External antenna

Connect the antenna cable to the SMA connection (pos. 1) of CIM 250. The antenna must be installed outside the control cabinet in a position with good reception conditions.
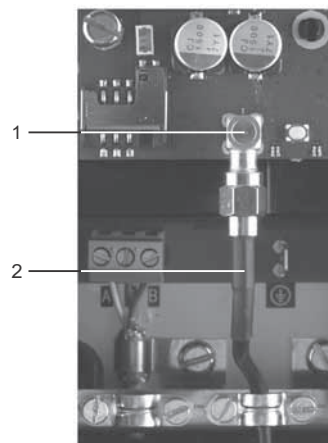
Fig. 10 Fitting an external GSM antenna

Pos.	Description
1	SMA connection for GSM antenna
2	Antenna cable for external GSM antenna

6.1.2 Inserting the SIM card

Before inserting the SIM card into CIM 250, remove the PIN code, or set the PIN code to "4321".

Procedure

1. Insert the SIM card into a mobile phone.
2. Remove the PIN code from the SIM card, or set the PIN code to "4321". See the manual of the mobile phone.
3. Insert the SIM card into CIM 250. See fig. 11.

The slanted edge of the SIM card must point downwards, away from the connector.

The connectors on the SIM card must face inwards towards CIM 250. See fig. 11.
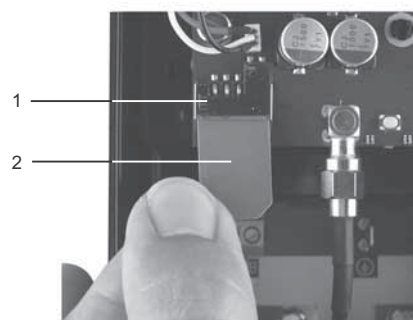
Fig. 11 Inserting the SIM card

Pos.	Description
1	SIM card holder
2	SIM card

6.1.3 Connecting the battery and power supply

WARNING

Electric shock

Death or serious personal injury

- Connect CIM 250 only to SELV or SELV-E circuits.

CAUTION

Flammable material

Minor or moderate personal injury

- Only insert the approved Grundfos battery pack (97631960).
- Never use this battery pack in other battery chargers.
- Do not dismantle or modify the battery.
- Do not heat or incinerate the battery.
- Do not pierce, crush or cause mechanical damage to the battery.
- Do not short circuit the battery.
- Do not allow the battery to get wet or be immersed in water.
- Do not strike or throw the battery.
- For long periods of storage, the temperature must be below 45 °C.

You can fit CIM 250 with a lithium-ion battery (order no. 97631960), which will ensure sustained GSM/GPRS connection with the product in which it is mounted, even if the power is switched off. The battery is secured by a velcro strap which absorbs vibrations and simplifies replacement. Connect the battery to CIM 250 as shown in fig. 12.

If a battery is not connected, the user will not receive any SMS alarm message in case of a power cut.
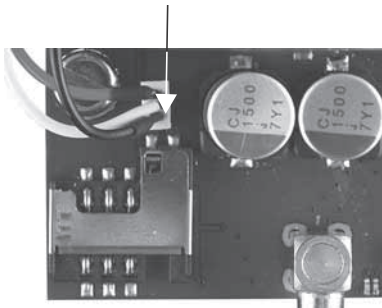
Fig. 12 Connecting the battery

TM04 2645 2808

You can only charge the battery if the battery temperature is within 0 to 45 °C.

Switch on the power supply. CIM 250 is powered either by the Grundfos product or by the battery.

The LED1 flashes yellow, searching for a GSM network. When the connection to the GSM network has been established, the LED1 will pulsate yellow, the GSM network is active. See fig. 13.

The LED2 must be permanently green, indicating that CIM 250 has been fitted correctly in the Grundfos product.

6.1.4 Configuration

For software configuration of CIM 250, which includes setting of SMS functions and SCADA communication parameters, see "CIM 250 SMS commands", supplement to the installation and operating instructions, on the CD-ROM supplied with the GSM module.

6.2 Status LEDs

The CIM 250 GSM module has two LEDs. See fig. 9.

- Yellow and green status LED, LED1, for GSM/GPRS communication.
- Red and green status LED, LED2, for internal communication between CIM 250 and the Grundfos product.

LED1, yellow and green

TM04 5194 4412

Yellow   Green

Fig. 13 LED1 status

Pos.	Status	Description
1	Flashing yellow	Searching for GSM network.
2	Pulsating yellow, single pulse	Connection to the GSM network has been established.
3	Permanently yellow	Call-up connection has been established.
4	Pulsating green, single pulse	Data are exchanged via GPRS.
5	Pulsating green, double pulse	Data are exchanged via the call-up connection.
6	Green, 3 seconds	Sending or receiving an SMS message.

LED2, red and green

Status	Description
Off	CIM 250 has been switched off.
Flashing red	No communication between CIM 250 and the Grundfos product.
Permanently red	CIM 250 does not support the connected version of the Grundfos product.
Permanently green	The connection between CIM 250 and the Grundfos product is OK.

7. Modbus TCP, CIM 500 setup

WARNING

Electric shock

Death or serious personal injury
- Connect CIM 500 only to SELV or SELV-E circuits.

7.1 Connecting the ethernet cable

Use RJ45 plugs and ethernet cable. Connect the cable shield to protective earth at both ends.

It is important to connect the cable shield to earth through an earth clamp or to connect the cable shield to earth in the connector.

CIM 500 is designed for flexible network installation; the built-in two-port switch makes it possible to daisy chain from product to product without the need of additional ethernet switches. The last product in the chain is only connected to one of the ethernet ports. Each ethernet port has its own MAC address.
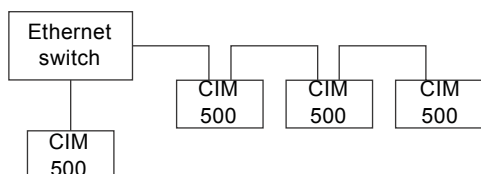
Fig. 14 Example of Industrial Ethernet network
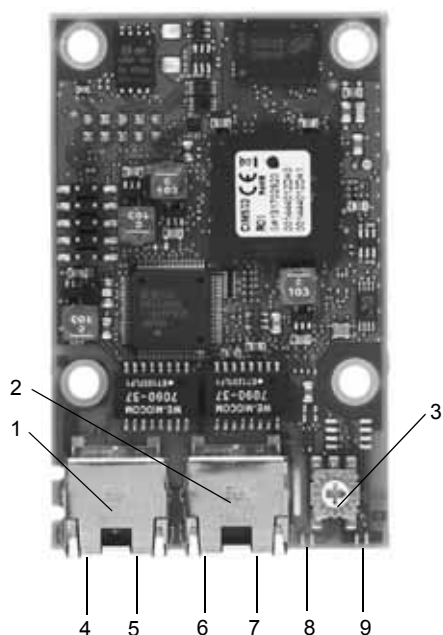
Fig. 15 Example of ethernet connection

Pos.	Description	Designation
1	Industrial Ethernet RJ45 connector 1	ETH1
2	Industrial Ethernet RJ45 connector 2	ETH2
3	Rotary switch for protocol selection	SW1
4	Data activity LED for connector 1	DATA1
5	Link LED for connector 1	LINK1
6	Data activity LED for connector 2	DATA2
7	Link LED for connector 2	LINK2
8	Green and red status LED for ethernet communication	LED 1
9	Green and red status LED for internal communication between the module and the pump.	LED 2

7.2 Setting the Industrial Ethernet protocol

The CIM 500 ethernet module has a rotary switch for selection of the Industrial Ethernet protocol. See fig. 16.
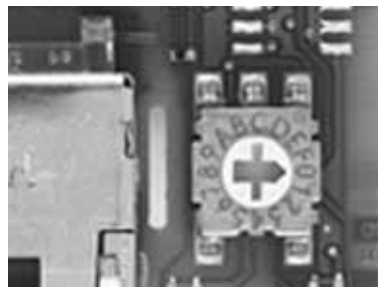
Fig. 16 Selecting the Industrial Ethernet protocol

Pos.	Description
0	PROFINET IO (default)
1	Modbus TCP
2	BACnet IP
3	EtherNet/IP
4	GRM IP. Requires a contract with Grundfos
5..E	Reserved, LED1 will be permanently red to indicate an invalid configuration
F	Reset to default setting Note: The rotary switch must be set in this position for 20 seconds to reset to default setting. During this period LED1 flashes red and green at the same time to indicate that a reset will occur.

Every change of the rotary-switch setting while the module is powered on will cause the module to restart.

7.3 Setting the IP addresses

The CIM 500 ethernet module is default set to a fixed IP address. You can change the IP address settings from the built in webserver.

Default IP settings used by webserver	IP address: 192.168.1.100 Subnet mask: 255.255.255.0 Gateway: 192.168.1.1
IP settings for Modbus TCP	Make the setting via the webserver

TM05 6435 4711

TM05 7431 1013

TM05 7431 1013

7.4 Establish a connection to the webserver

You can configure CIM 500 using the built-in webserver. To establish a connection from a PC to CIM 500 the following steps are required:

- Connect the PC and CIM 500 using an ethernet cable.
- Configure the PC ethernet port to the same subnetwork as CIM 500, for example 192.168.1.101, and the subnet mask to 255.255.255.0. See section *A.1 How to configure an IP address on your PC* on page 53.
- Open a standard internet browser and type 192.168.1.100 in the URL field.
- Log in to the webserver using the following:

User name	Default: admin.
Password	Default: Grundfos

User name and password may have been changed from their default values.
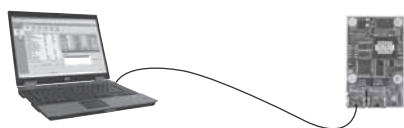
Fig. 17 CIM 500 connected to a PC via ethernet cable

For further information on how to use the webserver, see section *A.2 Webserver configuration* on page 53.

You can use both ETH1 and ETH2 to establish a connection to the webserver.

You can access the webserver while the selected Industrial Ethernet protocol is active.

7.5 Status LEDs

The CIM 500 ethernet module has two Status LEDs, LED1 and LED2.
See fig. 15.

- Red and green status LED, LED1, for ethernet communication
- Red and green status LED. LED2. for internal communication between CIM 500 and the Grundfos product.

LED1

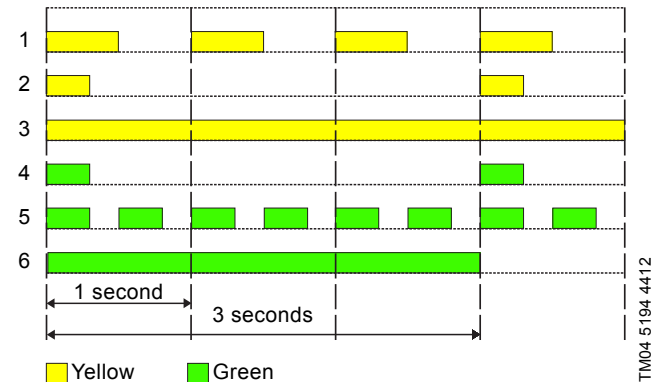| Status	Description
Off	No Modbus TCP communication or switched off.
Flashing green	Modbus TCP communication active.
Permanently red	CIM 500 module configuration fault. See section *15.3.1 LED status*.
Permanently red and green	Error in the firmware download. See section *15.3.1 LED status*.
Flashing red and green	Resetting to factory default. After 20 seconds CIM 500 restarts.

LED2

Status	Description
Off	CIM 500 is switched off.
Flashing red	No internal communication between CIM 500 and the Grundfos product.
Permanently red	CIM 500 does not support the Grundfos product connected.
Permanently green	Internal communication between CIM 500 and the Grundfos product is OK.
Permanently red and green	Memory fault.

During startup, there is a delay of up to 5 seconds before LED1 and LED2 status is updated.

7.6 DATA and LINK LEDs

The CIM 500 ethernet module has two connectivity LEDs related to each RJ45 connector. See fig. 15.

DATA1 and DATA2
These yellow LEDs indicate data traffic activity.

Status	Description
Yellow off	No data communication on the RJ45 connector.
Yellow flashing	Data communication ongoing on the RJ45 connector.
Permanently yellow	Heavy network traffic on the RJ45 connector.

LINK1 and LINK2
These green LEDs show whether the ethernet cable is properly connected.

Status	Description
Green off	No ethernet link on the RJ45 connector
Green on	Ethernet link on the RJ45 connector is OK

TM05 6436 4712

8. Modbus function code overview

The supported function codes are shown in the table below:

Type	Code	Hex	Name
16-bit data (registers)	03	0x03	Read holding registers
	04	0x04	Read input registers
	06	0x06	Write single register
	16	0x10	Write multiple registers
Diagnostics	08	08	Diagnostics See section *13.6 Diagnostics, 0x08* for subcodes.

! Reading or writing coils are not supported.

The same data are available in both holding registers and input registers, meaning that either function, 0x03 or 0x04, can be used for reading data.

9. Modbus register overview

9.1 Register block overview

The Modbus RTU registers are grouped in the following register blocks:

Start address	Register block	Permissions	Description
00001	CIM configuration	R/W	Configuration of the CIM module.
00021	CIM status	R	Status registers for the CIM module.
00101	Pit control and configuration	W	Registers for control and configuration of wastewater pit.
00201	Pit status	R	Registers for status from wastewater pit.
00301	Pit data	R	Registers for measured values from wastewater pit.
00401	Pump 1	R	Registers containing pump 1 data and status.
00451	Pump 2	R	Registers containing pump 2 data and status.
00701	Alarm simulation	R/W	Registers for simulation of alarms and warnings.
00751	User	R/W	Registers where the user can freely store data.
06001	Event log	R	Registers containing the latest 40 event log entries.

All addresses contain registers. Some are bit-interpreted while others are 16-bit values, or high or low order parts of 32-bit values. A data value of 65535 (0xFFFF) indicates "not available" when reading registers. The value of 65535 (0xFFFF) does not imply a "disable" when writing values.

Each register block will be specified in more detail in the following sections.

9.2 CIM configuration register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

Address	Register name	Description	CIM 200	CIM 250	CIM 500
00001	SlaveMinimumReplyDelay	The minimum reply delay from the slave in ms. Value range: 0-10000, meaning that a reply delay of up to 10 seconds. This delay is typically used in conjunction with a radio modem. The delay value is stored in the device and remains after a power-off. The delay set here is added to the internal delay in the device. Default setting: 0.	●	-	-
00002		RESERVED	-	-	-
00003	SoftwareDefinedModbusAddress	This register holds the active Modbus address. The default setting is 0xE7 (231), and there is normally no need to change this value. Note: For CIM 200, this value is used only when you have set the transmission speed to "Software-defined" on the DIP switches SW4 and SW5. Otherwise, the slave will ignore it.	●	●	-
00004	SoftwareDefinedBitRate	Modbus software-defined transmission speed enumeration. The software-defined transmission-speed value is stored in the device and remains after a power-off. 0: 1200 bits/s 1: 2400 bits/s 2: 4800 bits/s 3: 9600 bits/s 4: 19200 bits/s 5: 38400 bits/s. Note: This value is used only when you have set the transmission speed to "Software-defined" on the DIP switches SW4 and SW5. Otherwise, the slave will ignore it.	●	-	-
00005	AutoAckControlBits	The register is used to select the behaviour of control bit acknowledgements from the module. 0: Disabled. Control bits are not automatically lowered when accepted by the device. The user must lower the triggered control bit manually before the control bit can be triggered again. 1: Enabled. Control bits are automatically lowered when accepted by the device. The user does not have to lower it manually (default).	●	●	●

Address	Register name	Description	CIM 200	CIM 250	CIM 500
00006	ReadWriteSeparation	The register is used to select the read-back behaviour of value-setting registers 00110-00128. 0: Read and write are not separated. The real value of the status register is reflected in its setting register. 1: Read and write are separated. The setting register reflects the value that was written to it the last time. It may differ from the real value of the status register that it represents. Example: If the high-level value is set with Grundfos GO Remote, it is shown in status register 00241 HighLevel. However, it is only shown in 00122 SetHighLevel if the ReadWriteSeparation register is set to 0.	●	●	●
00007		RESERVED	-	-	-
00008	NoDataActivityTimeout	The elapsed time with no data activity before the module issues a "GPRS restart".	-	●	-
00009	SoftwareDefinedParity	Parity setting for use when using "software-defined" settings. 0: No parity (default) 1: Even parity 2: Odd parity. Note: For CIM 200, this value is used only when you have set the transmission speed to "Software-defined" on the DIP switches SW4 and SW5. Otherwise, the slave will be ignored it.	●	-	-
00010	SoftwareDefinedStopBit	Stop-bit setting to be used when using "software-defined" settings. 0: No stop bit 1: 1 stop bit (default) 2: 2 stop bits. Note: For CIM 200, this value is used only when you have set the transmission speed to "Software-defined" on the DIP switches SW4 and SW5.	●	-	-
00011	ScadaPinCode	PIN code for SCADA systems, etc. If GeneralStatus.ScadaPinCodeEnabled (register 00029, bit 0) is enabled, enter the correct PIN code in this register in order to gain access to remote control and configuration. Verify acceptance in GeneralStatus.WriteAccess (register 00029, bit 1). You programme the SCADA PIN code via the SMS command SETSCADACODE. See "CIM 250 SMS commands", supplement to installation and operating instructions, on the CD-ROM supplied with the GSM module.	●	●	●
00012		RESERVED	-	-	-

9.3 CIM status register block

Registers in this block can be read by means of function codes
0x03 and/or 0x04. They are read-only. Use this block for various
kinds of fault finding.

Address	Register name	Description
00021	GENIbusCRCErrorCnt	Holds a CRC error counter for the GENIbus connection between CIM and LC 2X1.
00022	GENIbusDataErrorCnt	Holds a CRC error counter for the GENIbus connection between CIM and LC 2X1.
00023	VersionNumber	A Grundfos-specific version number. This is an unsigned integer value.
00024	ActualModbusAddress	The register holds the current Modbus slave address of the device. Valid value range: 1…247. Not used for CIM 500.
00025 00026	GENIbusTXcountHI GENIbusTXcountLO	The register holds a transmit counter for the total number of telegrams sent to the LC 2X1 on the GENIbus connection.
00027 00028	GENIbusRXcountHI GENIbusRXcountLO	The register holds a receive counter for the total number of telegrams received from the LC 2X1 on the GENIbus connection.
00029	GeneralStatus Bit 0: ScadaPinCodeEnabled	PIN code functionality. 0: No PIN code required 1: PIN code required to perform remote control and configuration. Activation of SCADA PIN code protection takes place via the SMS command SCADACODE. See "CIM 250 SMS commands", supplement to installation and operating instructions, on the CD-ROM supplied with the GSM module.
	GeneralStatus Bit 1: WriteAccess	Remote write access. 0: No write access, the PIN code is incorrect. 1: Full write access, the PIN code is either correct or not enabled.
00030	UnitFamily	Grundfos product family. LC 2X1 has value 48.
00031	UnitType	Grundfos product type. 1: modular type 2: wall-mounted type.
00032	UnitVersion	Grundfos product version.
00033	GSMBatteryState	State of GSM battery 0: Battery not present 1: Battery must be replaced 2: Battery charging 3: Battery needs charging, but temperature too high 4: Battery needs charging, but temperature too low 5: Battery low 6: Battery OK 255: Battery state not available
00034	ProductSoftwareVersionHI	Product software version (BCD digit 1-4 aa.bb)
00035	ProductSoftwareVersionLO	Product software version (BCD digit 5-8 cc.dd)
00036	ProductSoftwareDayMonth	Product software date (BCD ddmm)
00037	ProductSoftwareYear	Product software date (BCD yyyy)

9.4 Pit control and configuration register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

Unless otherwise stated, the data type used for counters and scaled values is always an unsigned integer.

Address	Register name	Scale	Description
00101	PitControl Bit 0: ResetAlarm	Bool	Control bit that resets alarms and warnings from LC 2X1. 0: No resetting 1: Resetting alarm. This control bit is triggered on rising edge only so if the register is changed from 0 to 1, LC 2X1 resets the alarm. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
	PitControl Bit 2: ResetEventLog	Bool	Control bit that resets the SCADA event log in LC 2X1. 0: No resetting 1: Resetting event log. This control bit is triggered on rising edge only so if the register is changed from 0 to 1, LC 2X1 resets the alarm. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
00103	PitPump1Control	Enum	Remote manual control of pump 1. 0: "Auto" mode. The pump is controlled by LC 2X1. 1: Forced start 2: Forced stop.
00104	PitPump2Control	Enum	Remote manual control of pump 2. 0: "Auto" mode. The pump is controlled by LC 2X1. 1: Forced start 2: Forced stop.
00110	SetEventLogClearID	Unscaled	Selects which records to clear in the event log.
00122	SetHighLevel	0.01 m	Setting a new level for activation of high-level alarm.*
00124	SetDryRunningLevel	0.01 m	Setting a new level for activation of dry-running alarm.*
00126	SetStartLevelPump1	0.01 m	Setting a new start level for pump 1.*
00127	SetStopLevelPump1	0.01 m	Setting a new stop level for pump 1.*
00128	SetStartLevelPump2	0.01 m	Setting a new start level for pump 2.*

*   If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM module will overwrite this register value with the resulting level.

9.5 Pit status register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. It is not possible to write to these registers.

Unless otherwise stated, the data type used for counters and scaled values is always an unsigned integer.

Address	Register name	Scale	Description
00201	AcknowledgeRegister Bit 0: AckResetAlarm	Bool	Indicates if a ResetAlarm control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to "0". 0: Not acknowledged 1: Acknowledged.
	AcknowledgeRegister Bit 2: AckResetEventLog	Bool	Indicates if a ResetEventLog control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to "0". 0: Not acknowledged 1: Acknowledged.
00202	PitStatus Bit 0: RESERVED	-	-
	PitStatus Bit 1: AlarmActive	Bool	Alarm condition. 0: No active alarms 1: One or more active alarms.
	PitStatus Bit 2: WarningActive	Bool	Warning condition. 0: No active warnings 1: One or more active warnings.
	PitStatus Bit 3: ManualControl	Bool	Manual control condition. 0: No manual control 1: Manual control.
00203	OperatingMode	enum	Register for reading the actual operating mode of the pit. 0: Standby, stopped from level control 1: Startup delay 2: Pumping 3: Stop delay 4: Pumping max. 5: Stopped 8: Pump anti-seizing 9: Manual control, all enabled pumps in manual control mode 12: Level-sensor fault 13: All enabled pumps in alarm 14: All pumps out of operation
00204	PitPumpsPresence Bit 0: Pump1Presence	Bool	Presence of pump 1. 0: Not present 1: Present.
	PitPumpsPresence Bit 1: Pump2Presence	Bool	Presence of pump 2. 0: Not present 1: Present.
00206	PitPumpsRunning Bit 0: Pump1Running	Bool	Running state of pump 1. 0: Not running 1: Running.
	PitPumpsRunning Bit 1: Pump2Running	Bool	Running state of pump 2. 0: Not running 1: Running.
00207	PitPumpsMonitoringFault Bit 0: Pump1MonitoringFault	Bool	Fault state of pump 1 monitoring devices, always 0. 0: No fault 1: Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 1: Pump2MonitoringFault	Bool	Fault state of pump 2 monitoring devices, always 0. 0: No fault 1: Fault in auxiliary equipment or sensors.
00208	PitPumpsWarning Bit 0: Pump1Warning	Bool	Warning state of pump 1. 0: No warning 1: Warning.
	PitPumpsWarning Bit 1: Pump2Warning	Bool	Warning state of pump 2. 0: No warning 1: Warning.
00209	PitPumpsAlarm Bit 0: Pump1Alarm	Bool	Alarm state of pump 1. 0: No alarm 1: Alarm.
	PitPumpsAlarm Bit 1: Pump2Alarm	Bool	Alarm state of pump 2. 0: No alarm 1: Alarm.

Address	Register name	Scale	Description
00210	PitAlarms1	Bits	Pit alarm events, item 1. Bit-interpreted. See section *11.6 Alarms and warnings*
00211	PitAlarms2	Bits	Pit alarm events, item 2. Bit-interpreted. See section *11.6 Alarms and warnings*
00212	PitAlarms3	Bits	Pit alarm events, item 3. Bit-interpreted. See section *11.6 Alarms and warnings*
00213	PitWarnings1	Bits	Pit warning events, item 1. Bit-interpreted. See section *11.6 Alarms and warnings*
00214	PitWarnings2	Bits	Pit warning events, item 2. Bit-interpreted. See section *11.6 Alarms and warnings*
00215	PitWarnings3	Bits	Pit warning events, item 3. Bit-interpreted. See section *11.6 Alarms and warnings*
00216	EventLogLatestID	Unscaled	ID code of the latest event log.
00217	NumberOfFloatSwitches	enum	Number of installed float switches in the pit, 0-5.
00218	FloatSwitchesStatus Bit 0: FloatSwitch1Status	Bool	On and off state of float switch 1, if installed. 0: Off 1: On.
	FloatSwitchesStatus Bit 1: FloatSwitch2Status	Bool	On and off state of float switch 2, if installed. 0: Off 1: On.
	FloatSwitchesStatus Bit 2: FloatSwitch3Status	Bool	On and off state of float switch 3, if installed. 0: Off 1: On.
	FloatSwitchesStatus Bit 3: FloatSwitch4Status	Bool	On and off state of float switch 4, if installed. 0: Off 1: On.
	FloatSwitchesStatus Bit 4: FloatSwitch5Status	Bool	On and off state of float switch 5, if installed. 0: Off 1: On.
00219	FloatSwitch1Function	enum	Function of the float switch. 0: RESERVED 1: Dry running 2: - 3: Stop of all pumps 11: Start or stop 14: Start of first pump 15: Start of second pump 23: High level.
00220	FloatSwitch2Function	enum	Function of the float switch. 0: RESERVED 1: Dry running 2: - 3: Stop of all pumps 11: Start or stop 14: Start of first pump 15: Start of second pump 23: High level.
00221	FloatSwitch3Function	enum	Function of the float switch. 0: RESERVED 1: Dry running 2: - 3: Stop of all pumps 11: Start or stop 14: Start of first pump 15: Start of second pump 23: High level.
00222	FloatSwitch4Function	enum	Function of the float switch. 0: RESERVED 1: Dry running 2: - 3: Stop of all pumps 11: Start or stop 14: Start of first pump 15: Start of second pump 23: High level.

Address	Register name	Scale	Description
00223	FloatSwitch5Function	enum	Function of the float switch. 0: RESERVED 1: Dry running 2: - 3: Stop of all pumps 11: Start or stop 14: Start of first pump 15: Start of second pump 23: High level.
00224	Bits 0		RESERVED
	PitSensors Bits 1: PressureSensor	Bool	Presence of pressure sensor via analog input. 0: Not present 1: Present.
	PitSensors Bits 2: FloatSwitches	Bool	Presence of float switches. 0: Not present 1: Present.
00236	GSMSignalLevelActual	1 %	Actual value of GSM signal level. 254: Signal level not detectable. 255: GSM network not available. Note: Only for CIM 250.
00237	GSMSignalLevelAverage	1 %	Average value of GSM signal level. 254: Signal level not detectable. 255: GSM network not available. Note: Only for CIM 250.
00238	IPAddressHI	Unscaled	High-order part of IP address. GPRS only. Note: Only for CIM 250.
00239	IPAddressLO	Unscaled	Low-order part of IP address. GPRS only. Note: Only for CIM 250.
00241	HighLevel	0.01 m	Level for activation of high-level alarm.
00243	DryRunningLevel	0.01 m	Level for activation of dry-running level alarm.
00245	StartLevelPump1	0.01 m	Start level for pump 1.
00246	StopLevelPump1	0.01 m	Stop level for pump 1.
00247	StartLevelPump2	0.01 m	Start level for pump 2.

9.6 Pit data register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. It is not possible to write to these registers.

Unless otherwise stated, the data type used for counters and scaled values is always an unsigned integer.

The table below shows for which LC 2X1 type the registers are supported.

0xFFFF indicates that the data value is not available.

Address	Register name	Scale	Description
00301	PitWaterLevel	0.01 m	Sensor-measured water level in the pit. Requires a level sensor.
00308	PitPowerHI	1 W	Power consumption of the pit.
00309	PitPowerLO		
00310	PitEnergyHI	0.1 kWh	Energy consumption of the pit.
00311	PitEnergyLO		
00329	PitOperatingTimeHI	1 minute	Total pit operating time (power-on time).
00330	PitOperatingTimeLO		
00351	UserAnalogInput 1	0.1 %	User-defined measurement, analog input 1.*
00352	UserAnalogInput 2	0.1 %	User-defined measurement, analog input 2.*
00353	UserAnalogInput 3	0.1 %	User-defined measurement, analog input 3.*
00391	UserDigitalInBlock1	Bits	User digital-inputs bits 15-0 (= DI16-DI1).*
00392	UserDigitalInBlock2	Bits	User digital-inputs bits 31-16(= DI32-DI17).*
00393	UserDigitalOutputs	Bits	User digital-outputs bits 15-0 (= DO16-DO1).*
00394	UserAnalogInput4	0.1 %	User-defined measurement, analog input 4.*
00395	UserAnalogInput5	0.1 %	User-defined measurement, analog input 5.*

*   See page 24 for LC 231 IO terminal mapping and page 25 for LC 241 IO terminal mapping.

9.7 LC 231 IO terminal mapping, wall-mount version

DIO3 GND DIO4 GND DI1 GND DI2 GND

CIO1 GND CIO2 GND 24V GND 24V GND
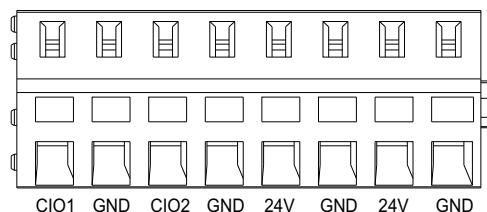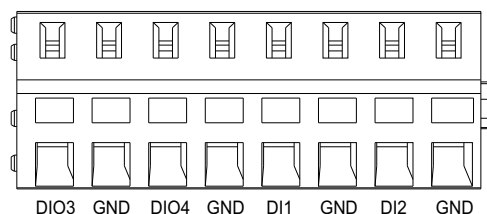
TM07 0760 0518

Terminal		Address	Register name	Scale	Description
CT 1 (optional)		00418	Pump1Current	0.1 A	Pump 1 current-transformer measurement
CT 2 (optional)		00468	Pump2Current	0.1 A	Pump 2 current-transformer measurement
DI 1		00391 bit 0	UserDigitalInBlock1 bit 0	Bool	User configurable digital input 1
DI 2		00391 bit 1	UserDigitalInBlock1 bit 1	Bool	User configurable digital input 2
Rel 1		00393 bit 0	UserDigitalOutputs bit 0	Bool	User configurable output relay 1
Rel 2		00393 bit 1	UserDigitalOutputs bit 1	Bool	User configurable output relay 2
DIO 3	As DI	00391 bit 2	UserDigitalInBlock1 bit 2	Bool	User configurable digital input 3
	As DO	00393 bit 2	UserDigitalOutputs bit 2	Bool	User configurable digital output 3
DIO 4	As DI	00391 bit 3	UserDigitalInBlock1 bit 3	Bool	User configurable digital input 4
	As DO	00393 bit 3	UserDigitalOutputs bit 3	Bool	User configurable digital output 4
CIO 1	As DI	00391 bit 4	UserDigitalInBlock1 bit 4	Bool	User configurable digital input 5
	As DO	00393 bit 4	UserDigitalOutputs bit 4	Bool	User configurable digital output 5
	As AI/PT	00351	UserAnalogInput1	0.1 %	User configurable analog input 1
	As AO	Future	-	-	-
CIO 2	As DI	00391 bit 4	UserDigitalInBlock1 bit 5	Bool	User configurable digital input 6
	As DO	00393 bit 5	UserDigitalOutputs bit 5	Bool	User configurable digital output 6
	As AI/PT	00352	UserAnalogInput2	0.1 %	User configurable analog input 2
	As AO	Future	-	-	-

A few IO terminals are dedicated to a specific functionality and are not mapped: PTC1, PTC2.

9.8 LC 241 IO terminal mapping, modular version

LC 241 consists of a control cabinet with a CU 241 control unit, an IO 242 pump module for connection of one or two pumps, some basic IO signals and an optional IO 241 module for extra IO signals. The mapping of the wire terminlas to Modbus registers for the two IO modules are shown in this section.
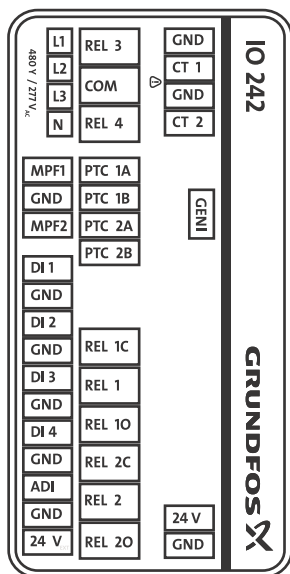
TM07 0632 0418

IO 242 pump module

Terminal		Address	Register name	Scale	Description
CT 1		00418	Pump1Current	0.1 A	Pump 1 current-transformer measurement
CT 2		00468	Pump2Current	0.1 A	Pump 2 current-transformer measurement
DI 1		00391 bit 0	UserDigitalInBlock1 bit 0	Bool	User configurable digital input 1
DI 2		00391 bit 1	UserDigitalInBlock1 bit 1	Bool	User configurable digital input 2
DI 3		00391 bit 2	UserDigitalInBlock1 bit 2	Bool	User configurable digital input 3
DI 4		00391 bit 3	UserDigitalInBlock1 bit 3	Bool	User configurable digital input 4
ADI	As DI	00391 bit 4	UserDigitalInBlock1 bit 4	Bool	User configurable digital input 5
	As AI	00351	UserAnalogInput1	0.1 %	User configurable analog input 1
Rel 1		00393 bit 0	UserDigitalOutputs bit 0	Bool	User configurable output relay 1
Rel 2		00393 bit 1	UserDigitalOutputs bit 1	Bool	User configurable output relay 2

A few IO 242 terminals are dedicated to a specific functionality and are not mapped: PTC1, PTC2, MPF1, MPF2, REL3, REL4.
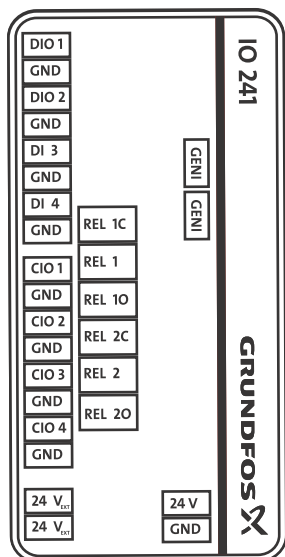
TM07 0631 0418

IO 241 extended IO

Terminal		Address	Register name	Scale	Description
DIO 1	As DI	00391 bit 5	UserDigitalInBlock1 bit 5	Bool	User configurable digital input 6
	As DO	00393 bit 2	UserDigitalOutputs bit 2	Bool	User configurable digital output 3
DIO 2	As DI	00391 bit 6	UserDigitalInBlock1 bit 6	Bool	User configurable digital input 7
	As DO	00393 bit 3	UserDigitalOutputs bit 3	Bool	User configurable digital output 4
DI 3		00391 bit 7	UserDigitalInBlock1 bit 7	Bool	User configurable digital input 8
DI 4		00391 bit 8	UserDigitalInBlock1 bit 8	Bool	User configurable digital input 9
CIO 1	As DI	00391 bit 9	UserDigitalInBlock1 bit 9	Bool	User configurable digital input 10
	As DO	00393 bit 4	UserDigitalOutputs bit 4	Bool	User configurable digital output 5
	As AI/PT	00352	UserAnalogInput2	0.1 %	User configurable analog input 2
	As AO	Future	-	-	-
CIO 2	As DI	00391 bit 10	UserDigitalInBlock1 bit 10	Bool	User configurable digital input 11
	As DO	00393 bit 5	UserDigitalOutputs bit 5	Bool	User configurable digital output 6
	As AI/PT	00353	UserAnalogInput3	0.1 %	User configurable analog input 3
	As AO	Future	-	-	-
CIO 3	As DI	00391 bit 11	UserDigitalInBlock1 bit 11	Bool	User configurable digital input 12
	As DO	00393 bit 6	UserDigitalOutputs bit 6	Bool	User configurable digital output 7
	As AI/PT	00394	UserAnalogInput4	0.1 %	User configurable analog input 4
	As AO	Future	-	-	-
CIO 4	As DI	00391 bit 12	UserDigitalInBlock1 bit 12	Bool	User configurable digital input 13
	As DO	00393 bit 7	UserDigitalOutputs bit 7	Bool	User configurable digital output 8
	As AI/PT	00395	UserAnalogInput5	0.1 %	User configurable analog input 5
	As AO	Future	-	-	-
Rel 1		00393 bit 8	UserDigitalOutputs bit 8	Bool	User configurable digital output 9
Rel 2		00393 bit 9	UserDigitalOutputs bit 9	Bool	User configurable digital output 10

9.9 Pump 1 register block

All register values are read-only, and 0xFFFF indicates that the data value is not available.

Unless otherwise stated, the data type used for counters and scaled values is always an unsigned integer.

Address	Register name	Scale	Description
00401	Pump1Status Bit 0: Presence	Bool	Presence of the pump. 0: Not present 1: Present.
	Pump1Status Bit 1: Running	Bool	Running state of the pump. 0: Not running 1: Running.
	Pump1Status Bit 3: Warning	Bool	Warning state of the pump. 0: No warning 1: Warning.
	Pump1Status Bit 4: Alarm	Bool	Alarm state of the pump. 0: No alarm 1: Alarm.
00402	Pump1ControlSource	enum	Control source of the pump. 0: Auto 1: Manually by switch 2: Manually via display 3: Remote-controlled by bus.
00403	Pump1ConnectionType	enum	Pump-connection type. 0: Pump connected to wall-mounted controller or not present 1: Pump connected via pump module.
00404	Pump1OperatingTimeHI	1 minute	Total operating time.
00405	Pump1OperatingTimeLO		
00406	Pump1TimeToServiceHI	1 minute	Time to next service.
00407	Pump1TimeToServiceLO		
00408	Pump1OperatingTimeYesterday	1 minute	Operating time yesterday.
00410	Pump1LatestOperatingTime	1 second	Operating time last time it was operated.
00411	Pump1StartCounterHI	Unscaled	Total number of pump starts.
00412	Pump1StartCounterLO		
00413	Pump1StartCounterYesterday	Unscaled	Total number of pump starts yesterday.
00415	Pump1StartsPerHour	Unscaled	Number of pump starts within the last hour.
00418	Pump1Current	0.1 A	Motor current.
00423	Pump1Alarms1	Bits	See section *11.6 Alarms and warnings*.
00424	Pump1Alarms2	Bits	See section *11.6 Alarms and warnings*.
00425	Pump1Alarms3	Bits	See section *11.6 Alarms and warnings*.
00427	Pump1Warnings2	Bits	See section *11.6 Alarms and warnings*.
00431	Pump1PowerHI	1 W	Power consumption.
00432	Pump1PowerLO		
00433	Pump1EnergyHI	0.1 kWh	Energy consumption.
00434	Pump1EnergyLO		

9.10 Pump 2 register block

All register values are read-only, and 0xFFFF indicates that the data value is not available.

Unless otherwise stated, the data type used for counters and scaled values is always an unsigned integer.

Address	Register name	Scale	Description
00451	Pump2Status Bit 0: Presence	Bool	Presence of the pump. 0: Not present 1: Present.
	Pump2Status Bit 1: Running	Bool	Running state of the pump. 0: Not running 1: Running.
	Pump2Status Bit 3: Warning	Bool	Warning state of the pump. 0: No warning 1: Warning.
	Pump2Status Bit 4: Alarm	Bool	Alarm state of the pump. 0: No alarm 1: Alarm.
	Pump2Status Bit 11: PumpDisabled	Bool	Enabled or disabled state of the pump. 0: Enabled 1: Disabled, for example for temporary maintenance.
00452	Pump2ControlSource	enum	Control source of the pump. 0: Auto 1: Manually by switch 2: Manually via display 3: Remote-controlled by bus.
00453	Pump2ConnectionType	enum	Pump-connection type. 0: Pump connected to wall-mounted controller or not present 1: Pump connected via pump module.
00454	Pump2OperatingTimeHI	1 minute	Total operating time.
00455	Pump2OperatingTimeLO		
00456	Pump2TimeToServiceHI	1 minute	Time to next service.
00457	Pump2TimeToServiceLO		
00458	Pump2OperatingTimeYesterday	1 minute	Operating time yesterday.
00460	Pump2LatestOperatingTime	1 second	Operating time last time it was operated.
00461	Pump2StartCounterHI	Unscaled	Total number of pump starts.
00462	Pump2StartCounterLO		
00463	Pump2StartCounterYesterday	Unscaled	Total number of pump starts yesterday.
00465	Pump2StartsPerHour	Unscaled	Number of pump starts within the last hour.
00468	Pump2Current	0.1 A	Motor current.
00473	Pump2Alarms1	Bits	See section *11.6 Alarms and warnings*
00474	Pump2Alarms2	Bits	See section *11.6 Alarms and warnings*
00475	Pump2Alarms3	Bits	See section *11.6 Alarms and warnings*
00477	Pump2Warnings2	Bits	See section *11.6 Alarms and warnings*
00481	Pump2PowerHI	1 W	Power consumption.
00482	Pump2PowerLO		
00483	Pump2EnergyHI	0.1 kWh	Energy consumption.
00484	Pump2EnergyLO		

9.11 Alarm simulation register block

Address	Register name	R/W	Scale	Description
00703	SimulationEventCode	W	enum	Event code to simulate. Only supported codes can be used.
00704	SimulationDeviceType	W	enum	Device type to simulate. 0: system 6: pump
00705	SimulationDeviceNo	W	enum	Device number to simulate. 1: pump 1 2: pump 2
00708	SimulationActivate	W	Bool	Activation of simulation features. 0: Deactivate simulation 1: Activate simulation.
00709	SimulationActiveCode	R	enum	The active simulation event code.

9.12 User register block

Address	Register name	R/W	Scale	Description
00751-00800	UserRegisters	R/W	Unscaled	This area is for device labelling by the user. The user area values are stored in the device and will remain after a power-off.

9.13 Event log register block

The event log contains the latest 40 event entries. Each entry consists of seven registers, containing information about the event.

Address	Register name	Scale	Description
06001	NoOfEventsInLog	Unscaled	Number of events in the event log.
06002	EventIDLog1	Unscaled	Event ID for logged event No 1.
06003	EventCodeLog1	enum	Event code for logged event No 1.
06004	EventSourceLog1	enum	Event source for logged event No 1. 0: System 6: Pump.
06005	EventDeviceNo	Unscaled	Device number related to the event or its recognition. 0: No related number 1: Value of related number, pump 1 2: Value of related number, pump 2.
06006	EventTypeAndConditionLog1	enum	Event type and condition of logged event No 1. 0. - 1: Alarm condition appears 2: Alarm condition disappears 3: Warning condition appears 4: Warning condition disappears.
06007	EventTimeStampLog1HI	1 second	Seconds since midnight January 1st 1970 (UNIX time).
06008	EventTimeStampLog1LO		
06009-06274	Event log 2…39	-	-
06275	EventIDLog40	Unscaled	Event ID for logged event No 40.
06276	EventCodeLog40	enum	Event code for logged event No 40.
06277	EventSourceLog40	enum	Event source for logged event No 40.
06278	EventDeviceNo	Unscaled	Device number related to the event or its recognition.
06279	EventTypeAndConditionLog40	enum	Event type and condition of logged event No 40.
06280	EventTimeStampLog40HI	1 second	Seconds since midnight January 1st 1970 (UNIX time).
06281	EventTimeStampLog40LO		

10. Modbus RTU commissioning, step-by-step guides

If the sensor configuration is changed, restart the unit
to ensure a correct scaling of the sensor value.

10.1 Hardware setup, CIM 200

Step	Action
1	Install CIM 200 in the Grundfos product according to the product documentation.
2	Complete the product configuration, for example sensor configuration. This can be done either on the product's operating panel or via Grundfos GO Remote.
3	Select the Modbus slave address (1-247).
4	Select the bit rate of the Modbus slave.
5	Select parity and stop bits of the Modbus slave, even parity with 1 stop bit or no parity with 2 stop bits.
6	If necessary, set line termination.
7	Connect the necessary cables from CIM 200 to the Modbus network.
8	Confirm that the GENIbus LED is permanently green and that the Modbus LED is either off, if no master is actively polling the slave, or flashing green, indicating error-free communication.
	CIM 200 is now ready to be accessed via the Modbus network.

10.2 Hardware setup, CIM 250 GSM call-up

Step	Action
1	Install CIM 250 in the Grundfos product according to the product documentation.
2	Fit a GSM antenna to the module SMA connector. See section *6.1.1 Fitting a GSM antenna*.
3	Insert the SIM card in CIM 250. See section *6.1.2 Inserting the SIM card*.
4	Power on the Grundfos product.
5	Observe that LED2 turns permanently green, indicating that the module is fitted correctly. See section *6.2 Status LEDs*.
6	Observe that LED1 blinks yellow and changes to yellow pulsing after approximately 30 s, indicating that the GSM connection is working. See section *6.2 Status LEDs*. By making a call-up from a phone the connection can be verified. LED1 turns permanently yellow.
7	For configuring CIM 250 for a call-up connection, follow the instructions in the "CIM 250 SMS commands installation and operating instructions", included on CIM/CIU support files CD, section 2.1-3.
8	To verify the GSM settings after completion, the SMS command GSMSETTINGS can be used.
	CIM 250 is now ready to be accessed from a Modbus RTU master via GSM call-up or via SMS commands.

10.3 Hardware setup, CIM 250 GPRS connection

Step	Action
1	Install CIM 250 in the Grundfos product according to the product documentation.
2	Fit a GSM antenna to the module SMA connector. See section *6.1.1 Fitting a GSM antenna*.
3	Insert the SIM card in CIM 250. See section *6.1.2 Inserting the SIM card*.
4	Power on the Grundfos product.
5	Observe that LED2 turns permanently green. See section *6.2 Status LEDs*.
6	Observe that LED1 blinks yellow and changes to yellow pulsing after approximately 30 s, indicating that the GSM connection is working. See section *6.2 Status LEDs*.
7	For configuring CIM 250 for a GPRS connection, follow the instructions in the "CIM 250 SMS commands installation and operating instructions", included on CIM support files CD, sections 2.1, 2.2 and 2.4.
8	To verify the GPRS setting after completion, the SMS command GPRSSETTING can be used. To verify that the GPRS connection is working, the SMS command GPRSSTATUS can be used. The connection state must be "Context active" if ready and "Connected" if a Modbus TCP master is already communicating.
	CIM 250 is now ready to be accessed from a Modbus TCP master via GPRS or via SMS commands.

10.4 Modbus TCP communication setup, CIM 500

Step	Action
1	Install CIM 500 in the Grundfos product according to the product documentation.
2	Select position 1 at the protocol rotary switch. See section *7.2 Setting the Industrial Ethernet protocol*.
3	Power on the Grundfos product, and observe LED2 turn permanently green and LED1 remaining off.
4	Complete the product configuration, for example sensor configuration via Grundfos GO Remote.
5	Connect one of the CIM 500 ethernet ports (RJ45) to a PC using an ethernet cable.
6	Configure the PC ethernet port to the same subnetwork as CIM 500, for example 192.168.1.1, and the subnet mask to 255.255.255.0. See section *A.1 How to configure an IP address on your PC* on page 53.
7	Open your internet browser and make contact to the CIM 500 webserver. Default address: 192.168.1.100
8	Log in to the webserver. Default: User name: admin Password: Grundfos.
9	In the menu column to the left select: Configuration > Real time ethernet protocol
10	Key in an IP address belonging to the same subnet as your PC, for example 192.168.1.2.
11	Key in the subnet mask 255.255.255.0, and leave the rest of the settings at their factory default values.
12	Click [Submit] to transfer the new settings, and close the Web browser.

CIM 500 is now ready to be accessed from a Modbus TCP master via one of its ethernet ports. Use the IP address selected under step 9. The Modbus address (Unit ID) in the Modbus TCP telegram is not used.

• CIM 500 LED 1 will flash green when Modbus TCP communication takes place.
• You can use the two ethernet ports for daisy chaining of CIM 500 modules.
• It is possible to have connection to the webserver simultaneously with a connection to a Modbus TCP master.
• It is possible to have connection to more Modbus TCP masters simultaneously, for example to have connection to PC Tool CIM while connected to another Modbus TCP master.

11. Detailed descriptions of functionality

11.1 Separation of reads and writes

The functional profile supports Modbus holding registers, which means that registers can be both read and written. By default, most of the register values meant for writing by the Modbus master will also be updated by the LC 2X1 control unit itself, to reflect the actual value used by the LC 2X1.

Differences arise due to internal value limitations and because some settings and control values can have other sources, e.g. service port and display, that can change the actual values. To avoid such conflicts, the profile has the option of read and write separation with the option Config.ReadWriteSeparation (register 00006, bit 1 = 1). Using this option means that all writing registers [W] use an associated reading location [R] where the resulting status of the writing always can be verified. In this case reading and writing never take place via the same registers, Pit Event Simulation registers being the only exceptions. Reading a writing register only means reading what has previously been written to the Modbus interface, and in the general case this will not reflect what value the LC 2X1 control unit is actually using.

Example 1

Setting and reading overflow level with ReadWriteSeparation disabled (default).

The user writes a new value to SetHighLevel (register 00122).

The resulting high level is then read from SetHighLevel (register 00122).

ReadWriteSeparation is disabled by default.

Example 2

Setting and reading high level with ReadWriteSeparation enabled.

The user writes a new value to SetHIghLevel (register 00122).

The resulting high level is then read from HighLevel (register 00241), hence separating reads from writes.

11.2 Control bit acknowledgement

All control bits in the functional profile are triggered on the rising edge of a bit. The system supports two different approaches to control-bit acknowledgement: Auto and manual.

The AutoAckControlBits setting (register 00005) sets the desired approach:

0: Disabled.

Control bits are not automatically lowered when accepted by the device. The user must lower the control bit manually before the control bit can be triggered again. When a control bit is accepted by the device, the corresponding control-bit acknowledgement will be raised, and the user can lower the control bit.

1: Enabled.

Control bits are automatically lowered when accepted by the device, so the user does not have to lower it manually (default).

Example 1

ResetAlarm with auto-acknowledgement enabled (default).

The user sets the PitControl.ResetAlarm control-bit (register 00101, bit 0) to 1 to reset an alarm. When accepted by the slave, the PitControl.ResetAlarm control-bit is automatically reset to 0. The user can then set the PitControl.ResetAlarm control-bit to 1 again to reset an alarm again.

AutoAckEnabled is the default setting.

Example 2

ResetAlarm with auto-acknowledgement disabled.

The user sets the PitControl.ResetAlarm control-bit (register 00101, bit 0) to 1 to reset an alarm. When accepted by the slave, the AcknowledgeRegister.AckResetAlarm (register 00201, bit 0) is set to 1, and the PitControl.ResetAlarm is still 1. The user must then manually set PitControl.ResetAlarm to 0 before another alarm can be reset. When doing so, the AcknowledgeRegister.AckResetAlarm will revert to 0 as well.

11.3 GSM

11.3.1 Call-up functional description

The call-up function is used for SCADA system communication via the GSM network. Connection is established when the SCADA system dials LC 2X1. LC 2X1 will automatically "pick up the phone" and wait for data traffic in the form of Modbus RTU telegrams.

If legal data traffic has not been initiated within one minute, LC 2X1 hangs up the line. This silence timeout is active during the whole communication session. Whenever the SCADA system has completed the Modbus communication, it hangs up the line. This is detected by LC 2X1, which also hangs up the line, and the call-up communication session is thereby completed. See fig. 18.
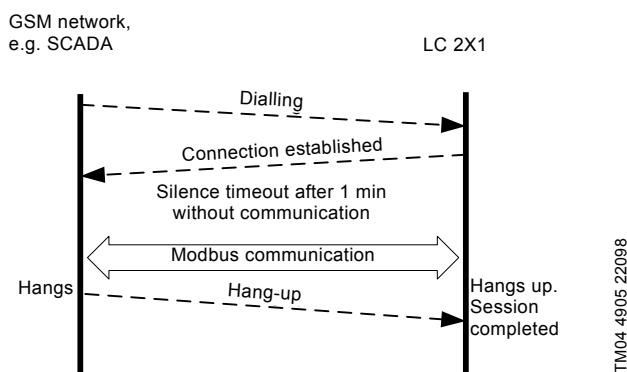
Fig. 18 Installation of a GSM call-up session

11.3.2 SCADA PIN code protection

It is always possible to get read access via Modbus. If LC 2X1 is SCADA PIN code-protected (GeneralStatus register 00029, bit 0 = 1), write access requires that the correct PIN code (ScadaPinCode, register 00011) has been written. Writing the correct PIN code will trigger the write access control, and write access will be open, which you can verify with GeneralStatus, register 00029, bit 1 = 1.

For call-up connections with PIN code protection, the ScadaPinCode register has to be written each time a new call-up is made.

11.3.3 GSM call-up options setup

To prepare LC 2X1 for Modbus communication with a SCADA system via GSM, some settings have to be made via SMS commands:

* Setting a SCADA PIN code:
  SETSCADACODE <access code> will enable write-access protection.

Default is an empty SCADA PIN code, meaning no protection.

* Activating the SCADA PIN code:
  SCADACODE <ON | OFF>.

Default is "Off".

* Selecting the Modbus address:
  MODBUSADDR <1-247>

Default value is 231.

To verify the SCADA GSM setting after completion, you can use the SMS command "SCADA".

For details about the use of SMS commands, see "CIM 25X SMS commands", supplement to the installation and operating instructions, on the CD-ROM supplied with the GSM module.

11.4 GPRS

11.4.1 GPRS and Modbus TCP

GPRS (General Packet Radio Service) is a wireless, always-on, connection that remains active as long as LC 2X1 is within range of the service. With GPRS, it is possible to establish a wireless connection to the internet and thus enable a remote connection to a SCADA-system computer or another PC application. Typical data rates are 32 to 48 kbit/s.

The GPRS itself takes care of the wireless data transfer via the GSM network. It plays the same role as ethernet in a wired network. On top of GPRS is the TCP/IP protocol, which enables easy integration with the internet. The Modbus TCP protocol is used on the application layer communicating with a TCP port number (default 502). The difference when compared with the fieldbus protocol Modbus RTU is the exclusion of the 16-bit CRC checksum and the adding of a Modbus-application program-header as illustrated in fig. 19.
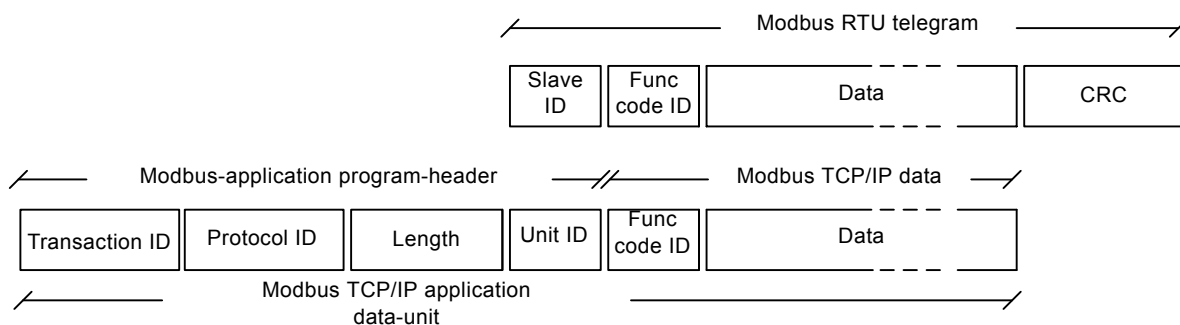
Fig. 19 Modbus TCP telegram

11.4.2 Subscription

The GSM service providers have different technical solutions for GPRS to choose from. You have to select the service provider and the technical solution that best suit your system, and it must be based on static IP addressing. You will get the following from the GSM service provider:

• A Subscriber Identity Module (SIM card).

• An Access Point Name (APN), for example "Internet".

• A user name is fixed and cannot be changed by the user.

• A password is fixed and cannot be changed by the user.

• A static IP address.

Solutions based on a VPN, Virtual Private Network, involve the use of special routers, for example GRE, Generic Routing Encapsulation, routers, which you will also get from the service provider.

11.4.3 Installation

To prepare LC 2X1 for GPRS communication, some settings have to be made via SMS commands:

- Select Access Point Name:
  APN <ASCII string>
  This is always mandatory.
- Select Username:
  USERNAME <ASCII string>
  The need for a user name depends on your operator and the type of subscription.
- Select Password:
  PASSWORD <ASCII string>
  The need for a password depends on your operator and the type of subscription.

Some advanced GPRS settings have default values that usually work, but in special cases, it might be necessary to change some of them. This is also done via SMS commands.

- Select Authentication:
  AUTHENTICATION <NORMAL | SECURE>
  Only used by some service providers. Default value is "Normal".
- Select Connection type:
  CONNECTION <SERVER | CLIENT | DISABLE>
  Default value is "Server".
- Set GPRS roaming:
  GPRSROAMING: <ON | OFF>
  Default value is "Off".
- Select Modbus TCP port number:
  MODBUSPORT <port no.>
  Default value is 502.
- Select GENIpro port number:
  GENIPROPORT <port no.>
  Default value is 49152. This is only relevant when using Grundfos PC Tools.

It is possible to configure the GPRS connection with a single multi-parameter command:

- SETGPRS
  – <parameters>:<APN>,<Modbus port>,<GENIproport>,
    <username>,<password>,<authentication>,<connection>,
    <GPRS roaming>

Example

SETGPRS
Grundfos.dk2.tdc,502,49888,Grundfos,4321,normal,server,off

To verify the GPRS setting after completion, you can use the SMS command GPRSSETTING. The command GPRSSTATUS can verify if the GPRS connection is working.

The connection states have the following meaning:

"Detached": Trying to locate GPRS service.

"Attached": GPRS service located.

"Context active": IP address has been assigned, ready for a client to establish a socket connection.

"Connected": A client has established a socket connection. The system is ready for TCP/IP data exchange, or already exchanging data.

For details about the use of SMS commands, see "CIM 25X SMS commands", supplement to the installation and operating instructions, on the CD-ROM supplied with the GSM module.

11.4.4 Operation

When you power on LC 2X1 with the correct GPRS setting, the following GPRS connection sequence will take place:

1. LC 2X1 locates the GPRS service. The connection state changes from "Detached" to "Attached".
2. LC 2X1 attempts to connect to the APN it has been given and requests an IP address. The base station looks through its record of legal SIM cards and finds the IP address, the address associated with this SIM card, to assign to LC 2X1. After LC 2X1 has got the IP address, the connection state changes to "Context active".
3. LC 2X1 is now ready for a client, for example a SCADA system, to establish a socket connection and begin TCP/IP data exchange. When a client connects LC 2X1, the connection state will change to "Connected", and the GSM status LED1 will indicate when data transfer takes place. See section *5.5 Status LEDs*.

> When no GPRS data is being transferred, the connection states "Attached", "Context active" and "Connected".
> All show the same LED1 status, short pulse.

A client, for example SCADA, establishes connection to LC 2X1 by specifying the IP address and the TCP port 502. Data transfer is always initiated from the client in the form of a Modbus TCP telegram embedded in a TCP/IP frame and directed to TCP port 502. To the client software, the connection to LC 2X1 is completely transparent.

The protection against unauthorised data access is high. The access to the GPRS network from the internet can only take place via the VPN tunnel. See fig. 21. Moreover, data transfer requires a Modbus master client, knowledge of the Modbus functional profile and the use of a SCADA PIN code, if enabled.

LC 2X1 supervises the GPRS system to ensure that it is still working. An automatic procedure ensures restarting of LC 2X1 and repetition of the GPRS connection sequence in case a deadlock situation has occurred. It also closes down socket connections that are left open by the client and unused for more than 24 hours.

It is possible to use SMS communication while GPRS communication is active. However, in the "Connected" state the delay time between reception and reply increases.

If the connection state is different from "Connected", it is possible to establish a call-up connection. When the call-up connection is established, GPRS data exchange will be blocked until the call-up is terminated by the caller.

A total of three Modbus clients can be connected to the Modbus TCP port of LC 2X1 and communicate simultaneously. Each connection, called a socket connection, is handled independently. If all three sockets are used simultaneously, a "Silence time-out" of only one minute is used to prevent a complete occupation for a long time.
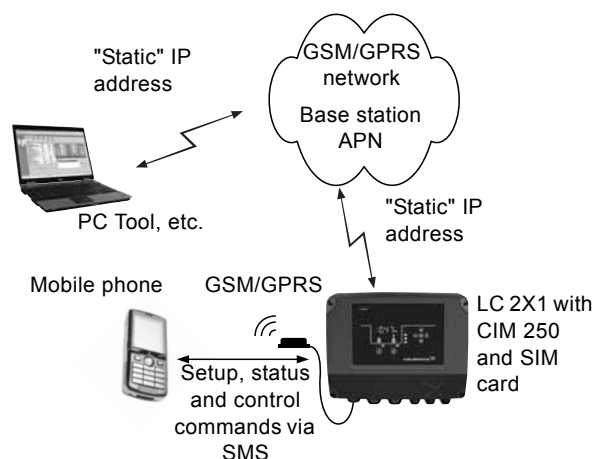
Fig. 20 GPRS connection from a PC to LC 2X1 directly via GPRS
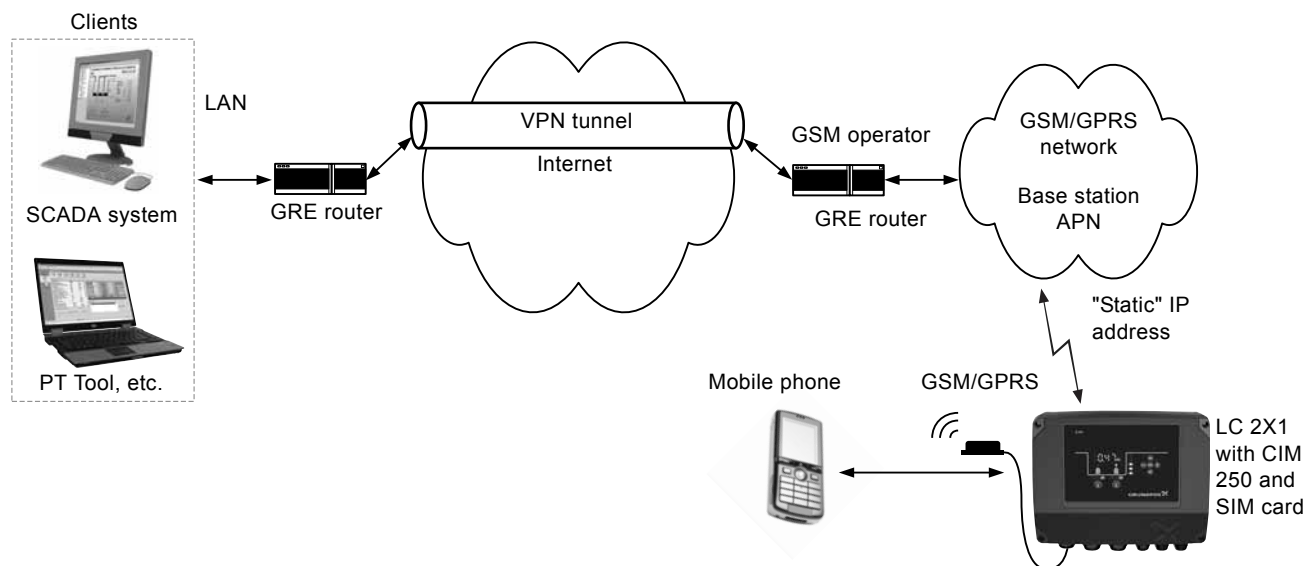
Fig. 21 GPRS connection via VPN tunnel

11.5 Event simulation

It is possible to simulate alarm/warning events by writing appropriate values to the following registers:

• SimulationEventCode (register 00703)
• SimulationDeviceType (register 00704)
• SimulationDeviceNo (register 00705).

Afterwards it is possible to trigger the simulated event via SimulationActivate (register 00708, bit 0). The event recording will take place as if the event was real, but the system operation will not be influenced.

The SimulationActiveCode (register 00709) can be used to check if event simulation is active. If the value is 0, there is no active event simulation.

By clearing the SimulationActivate (register 00708, bit 0) control bit, the simulated event is cancelled.

Event simulation procedure

• Write a valid event code, see section *9.11 Alarm simulation register block*, to SimulationEventCode (register 00703).
• Write a device type to SimulationDeviceType (register 00704), 0: system, 6: pump.
• Write a device number to SimulationDeviceNo (register 00705). 1: pump 1, 2: pump 2.
• Activate the alarm simulation with the above settings by writing 1 to SimulationActivate (register 00708, bit 0).

11.6 Alarms and warnings

These registers reflect the actual alarm and warning conditions of the pit or the pump. Alarms and warnings which have acknowledgement type "Auto-ack", will be cleared automatically when normal conditions are restored. Alarms and warnings which have acknowledgement type "Manual-ack", require a PitControl.ResetAlarm command to be cleared.

Warnings use the same bit interpretation as alarms.

Description	Data item	Code	Event source
Pit alarms 1 (register 00210) and Pit warnings 1 (register 00213)			
High-level alarm	PitAlarms/Warnings1.1	191	System
Dry-running alarm	PitAlarms/Warnings1.3	57	System
Float-switch sequence inconsistency	PitAlarms/Warnings1.5	205	System
Communication fault, I/O module	PitAlarms/Warnings1.11	226	Pump module
CIM fault (Communication Interface Module)	PitAlarms/Warnings1.12	159	Add-on CIM module
Pit alarms 2 (register 00211) and Pit warnings 2 (register 00214)			
Signal fault, user-defined sensor 1	PitAlarms/Warnings2.13	165	User-defined sensor, analog input 1
Pit alarms 3 (register 00212) and Pit warnings 3 (register 00215)			
Water-on-floor alarm	PitAlarms/Warnings3.1	229	System
User-event 1 alarm	PitAlarms/Warnings3.3	249	System
User-event 2 alarm	PitAlarms/Warnings3.4	250	System
RESERVED	PitAlarms/Warnings3.8-11	-	-
Intrusion, door opened	PitAlarms/Warnings3.12	117	System
Memory access error	PitAlarms/Warnings3.13	84	System
Internal communication error	PitAlarms/Warnings3.14	76	System
Setup conflict	PitAlarms/Warnings3.15	25	System
Pump alarms 1 (registers 00423, pump 1 and 00473, pump 2). **Pump warnings 1 (registers 00426, pump 1 and 00476, pump 2).**			
Motor-temperature alarm, PTC1	PumpAlarms/warnings1.0	69	Pump No [1; 2]
Motor-phase sequence reversal	PumpAlarms/Warnings1.9	9	Pump No [1; 2]
Motor overload (maximum current)	PumpAlarms/Warnings1.10	48	Pump No [1; 2]
Motor missing phase	PumpAlarms/Warnings1.13	2	Pump No [1; 2]
Pump alarms 2 (registers 00424, pump 1 and 00474, pump 2). **Pump warnings 2 (registers 00427, pump 1 and 00477, pump 2).**			
Motor-moisture switch	PumpAlarms/Warnings2.2	22	Pump No [1; 2]
Motor operating-time service-limit exceeded	PumpAlarms/Warnings2.8	12	Pump No [1; 2]
Too many pump auto-restarts (per 24 h)	PumpAlarms/Warnings2.9	4	Pump No [1; 2]
EEPROM error in parameter area	PumpAlarms/Warnings2.14	85	Pump No [1; 2]
Pump alarms 3 (registers 00425, pump 1 and 00475, pump 2). **Pump warnings 3 (registers 00428, pump 1 and 00478, pump 2).**			
Communication fault, pump module	PumpAlarms/Warnings3.1	225	Pump No [1; 2]
Setup conflict, parameters for current measurement	PumpAlarms/Warnings3.9	163	Pump No [1; 2]
General hardware fault	PumpAlarms/Warnings3.10	72	Pump No [1; 2]

12. Modbus function-code overview

The supported function codes are shown in the table below:

Type	Code	Hex	Name
16-bit data (registers)	03	0x03	Read holding registers
	04	0x04	Read input registers
	06	0x06	Write single register
	16	0x10	Write multiple registers
Diagnostics	08	08	Diagnostics See section *13.6 Diagnostics, 0x08* for subcodes.

Reading or writing coils are not supported.

The same data are available in both holding registers and input registers, meaning that either function, 0x03 or 0x04, can be used for reading data.

13. Modbus RTU telegram examples

The Modbus data model states that registers numbered X are addressed in telegrams as X - 1, for example register 00104, setpoint, is addressed as 00103 in a Modbus telegram.

Note that CRC fields are not shown in the following examples.

13.1 Modbus telegram overview

The maximum size of a Modbus RTU telegram is 256 bytes. Telegrams must be separated by a silent interval of at least 3.5 character times.

The standard Modbus RTU telegram format is shown in the table below.

Slave address	Function code	Data	CRC
1 byte	1 byte	0 to 252 bytes	2 bytes

A telegram starts with the slave address occupying one byte followed by a one-byte function code. Then comes a variable-size data field. For each telegram, a CRC is calculated and appended to the telegram, two bytes total. All bytes in the telegram, except for the CRC itself, are included in the check sum.

Note that the CRC bytes are not shown in the examples in the following sections.

13.2 Read holding registers, 0x03

This function is used for reading holding registers from the slave.

The request telegram specifies the starting address, that is the address of the first register to be read, and the number of holding registers to read. In the telegram, register addresses start from zero, meaning that registers numbered 1-16 are addressed as 0-15.

Example of a request from the master to a slave

Field	Value
Address	0x01
Function code	0x03
Start address HI	0x00
Start address LO	0x6B
Quantity HI	0x00
Quantity LO	0x03

In the request, the slave with address 1 is asked to deliver three contiguous registers starting from address 0x006b = 107, meaning register 108.

Example of a response from a slave to the master

Field	Value
Address	0x01
Function code	0x03
Byte count	0x06
Register 108 HI	0x00
Register 108 LO	0x01
Register 109 HI	0x00
Register 109 LO	0x01
Register 110 HI	0x00
Register 110 LO	0x01

In the response, the byte count is six since there are three registers of two bytes. All three registers hold the value of 0x0001.

13.3 Read input registers, 0x04

This function is used for reading input registers from the slave. Input registers are read-only registers by definition. The request telegram specifies the starting address, that is the address of the first register to be read, and the number of holding registers to read. In the telegram, register addresses start from zero, meaning that registers numbered 1-16 are addressed as 0-15.

Example of a request from the master to a slave

Field	Value
Address	0x01
Function code	0x04
Start address HI	0x10
Start address LO	0x10
Quantity HI	0x00
Quantity LO	0x03

In the request, the slave with address 1 is asked to deliver three contiguous registers starting from address 0x1010 = 4112, meaning register 4113.

Example of response from a slave to the master

Field	Value
Address	0x01
Function code	0x04
Byte count	0x06
Register 4113 HI	0x22
Register 4113 LO	0x22
Register 4114 HI	0x22
Register 4114 LO	0x22
Register 4115 HI	0x22
Register 4115 LO	0x22

In the response, the byte count is six since there are three registers of two bytes. All three registers hold the value of 0x2222.

13.4 Write single register, 0x06

This function is used for writing a single holding register in the slave. The request telegram specifies the address of the register that is to be written. Register addresses start from zero, meaning that a register numbered 10 is addressed as 9.

The normal response is an echo of the request, indicating that the value was written.

Example of a request from the master to a slave

Field	Value
Address	0x01
Function code	0x06
Address HI	0x10
Address LO	0x00
Value HI	0xAF
Value LO	0xFE

In the request, the slave with address 1 is asked to write the value of 0xAFFE to the register at address 0x1000.

Example of a response from a slave to the master

Field	Value
Address	0x01
Function code	0x06
Address HI	0x10
Address LO	0x00
Value HI	0xAF
Value LO	0xFE

The response is an echo of the request.

13.5 Write multiple registers, 0x10

This function is used for writing a block of contiguous holding registers in the slave. Register addresses start from zero, meaning that a register numbered 100 is addressed as 99.

Example of a request from the master to a slave

Field	Value
Address	0x01
Function code	0x10
Start address HI	0x00
Start address LO	0x20
Quantity HI	0x00
Quantity LO	0x02
Byte count	0x04
Register 33 HI	0x00
Register 33 LO	0x01
Register 34 HI	0xB0
Register 34 LO	0xB0

In the request, the slave with address 1 is asked to write the value of 0x0001 to the register at address 0x0020 and the value of 0xB0B0 to the register at address 0x0021.

Example of a response from a slave to the master

Field	Value
Address	0x01
Function code	0x10
Start address HI	0x00
Start address LO	0x20
Quantity written HI	0x00
Quantity written LO	0x02

The response returns the function code, starting address and quantity of registers written.

13.6 Diagnostics, 0x08

This function provides a test for checking the communication system between the master and the Grundfos slave. It contains a single-byte subcode to identify the test to be performed.

The following subcodes are supported:

Subcode	Name
0x00	Return query data. Data in this request are to be echoed in the response. The response must be identical to the request, so this function is often used to verify Modbus communication.
0x01	Restart communications. All communication counters are cleared, and the device is restarted.
0x02	Return diagnostics register. Returns the 16-bit diagnostics register. See section *13.7 Diagnostics register interpretation*.
0x04	Force listen only. Forces the device into listen-only mode. This effectively mutes the device, making it unable to communicate on the network. To bring the device back to normal mode, a "Restart communications" command, code 0x08, subcode 0x01, must be issued.
0x0A	Clear counters and diagnostics register. Clears all counters and the diagnostics register. These are also cleared on power-up and restart.
0x0B	Return bus message count. Returns the number of messages detected by the slave.
0x0C	Return bus CRC error count. Returns the number of CRC errors in the slave.
0x0D	Return bus exception count. Returns the number of Modbus exception responses that the slave has transmitted.
0x0E	Return slave message count. Returns the number of messages that the slave has processed.
0x0F	Return slave no response count. Returns the number of messages for which the slave has sent no response.
0x12	Return bus character overrun count. Returns the number of overruns in the slave.
0x14	Clear overrun counter. Clears the overrun counter. This is also cleared on power-up and restart.

13.7 Diagnostics register interpretation

The diagnostics register is interpreted as follows:

Bit	Description
0	Communication failure, with the Grundfos product.
1	EEPROM self-test has failed. The test is carried out when the system is booted.
2	Grundfos product is not supported.
3	Modbus address offset is different from default value, i.e. it differs from 0.
4	Using software-defined Modbus transmission speed.
5	RESERVED
6	RESERVED
7	RESERVED
8	RESERVED
9	RESERVED
10	RESERVED
11	RESERVED
12	RESERVED
13	RESERVED
14	RESERVED
15	RESERVED

A bit value of 1 means that the statement in the description is true, unless otherwise specified. The diagnostics register is read using function code 0x08 and subcode 0x02.

14. Modbus telegram application examples

The Modbus data model states that registers numbered X are addressed in telegrams as X - 1, for example register 00104, setpoint, is addressed as 00103 in a Modbus telegram.

Note that CRC fields are not shown in the following examples.

14.1 Diagnostics: return query data

This function is useful to ensure that the communication path and slave configuration are correct. It will echo the request in the response.

In the example, slave address 0x01 is used.

Request from the master to a slave

Field	Value	Description
Slave address	0x01	-
Function code	0x08	Diagnostics
Subcode	0x00	Echo request
Data	0xAB	Test data
Data	0xCD	Test data

Example of a response from a slave to the master

Field	Value	Description
Slave address	0x01	-
Function code	0x08	Diagnostics
Subcode	0x00	Echo request
Data	0xAB	Test data
Data	0xCD	Test data

If there is no response from the slave, see section *15.1.2 CIM 200 Modbus communication faults*.

14.2 Reading the pit water level

This section shows how to read and interpret the water level of the pit.

In the example, slave address 0x01 is used.

Request from the master to a slave

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Start address HI	0x01	Start register (00301)
Start address LO	0x2C	= 0x012D
Quantity HI	0x00	Number of registers
Quantity LO	0x01	= 0x0001

Example of a response from a slave to the master

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Byte count	0x02	2 bytes follow
00301 HI	0x00	Pit water level
00301 LO	0xDC	= 0x00DC (220)

A pit water-level value of 220 [0.01 m] equals a water level of 2.20 m.

If there is no response from the slave, see section *15.1.2 CIM 200 Modbus communication faults*.

14.3 Reading the pit alarms

This section shows how to read and interpret the three alarm registers of the pit. The pit alarms start at Modbus register address 210 = 0x00D2.

In the example, slave address 0x01 is used.

Request from the master to a slave

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Start address HI	0x00	Start register (00210)
Start address LO	0xD1	= 0x00D2
Quantity HI	0x00	Number of registers
Quantity LO	0x03	= 0x0003

Example of a response from a slave to the master

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Byte count	0x06	6 bytes follow
00210 HI	0x00	Pit alarms 1
00210 LO	0x08	
00211 HI	0x00	Pit alarms 2
00211 LO	0x00	
00212 HI	0x00	Pit alarms 3
00212 LO	0x00	

If there is no response from the slave, see section *15.1.2 CIM 200 Modbus communication faults*.

When reading the three pit alarm registers, the following data becomes available:

Pit alarms 1 = 0b 0000 0000 0000 1000

Pit alarms 2 = 0b 0000 0000 0000 0000

Pit alarms 3 = 0b 0000 0000 0000 0000.

As seen from the alarms table, the bit for dry-running alarm is set in pit alarms 1.

15. Fault finding the product

15.1 CIM 200

You can detect faults in CIM 200 by observing the status of the two communication LEDs. See the table below and section *4. Specifications*.

15.1.1 LED status

Fault (LED status)	Possible cause	Remedy
1. Both LED1 and LED2 remain off when the power supply is connected.	a) CIM 200 is fitted incorrectly in LC 2X1.	Ensure that CIM 200 is fitted and connected correctly.
	b) CIM 200 is defective.	Replace CIM 200.
2. LED2 for internal communication is flashing red.	a) No internal communication between CIM 200 and LC 2X1.	Ensure that CIM 200 is fitted correctly in LC 2X1.
3. LED2 for internal communication is permanently red.	a) CIM 200 does not support the connected LC 2X1.	Contact the nearest Grundfos company.
4. Modbus LED1 is permanently red.	a) Fault in the CIM 200 Modbus configuration.	• Check the transmission speed, switches SW4 and SW5. If the switches are set to "software-defined", an invalid value may have been set via Modbus. Try one of the preselected transmission speeds, forexample 19200 bits/s. • Check that the Modbus address, switches SW6 and SW7, has a valid value [1-247].
5. Modbus LED1 is flashing red.	a) Fault in the Modbus communication, fault in parity or cyclic redundancy check.	• Check the transmission speed, switches SW4 and SW5. See section *5.1 Setting the Modbus transmission speed*. • Check the parity setting, switch SW3. See section *5.2 Setting the parity*. • Check the cable connection between CIM 200 and the Modbus network. • Check the termination resistor settings, switches SW1 and SW2. See section *5.4 Termination resistor*.

15.1.2 CIM 200 Modbus communication faults

Fault	Possible cause	Remedy
1. The slave does not respond to telegrams.	a) Configuration or wiring error.	• Check the visual diagnostics on the Modbus slave. Is the Grundfos GENIbus LED flashing green and the Modbus LED off or flashing green? • Ensure that the cable between the Modbus master and the Modbus slave is connected correctly. See section *5. Modbus RTU, CIM 200 setup* for wiring recommendations. • Ensure that the slave address is configured correctly, and that the correct slave address is used in the Modbus master poll. See section *5.3 Modbus address selection* for slave address selection. • Ensure that the transmission speed and stop bit/parity settings are configured correctly in both master and slave. • Ensure that each end of the Modbus trunk cable is terminated, if necessary. See section *5.4 Termination resistor* for line termination of the Grundfos slave. • Ensure that the bus topology for a Modbus network is correct.
	b) The slave may be in listen-only mode.	Either send a restart communications diagnostics command, or restart the Grundfos product manually.
	c) If the holding register of address 00001 "SlaveMinimumReplyDelay" is set too high, the master may time out before receiving the response from the slave.	Increase the timeout span in the master in order to communicate.
2. The slave responds with exception response 0x01: "Invalid function".	a) The master is trying to use an unsupported function in CIM 200.	See section *8. Modbus function code overview* for supported function codes. Note that reading and writing coils are not supported, so only register functions and diagnostics will be valid.
3. The slave responds with exception response 0x02: "Invalid data address".	a) The master is trying to read or write an invalid data address. If a master tries to read register addresses that are not listed in the tables, the slave will respond with this exception response. Some masters may automatically try to read large blocks in one telegram, which will cause problems if some of the registers in the block are not supported. An example would be reading the CIM configuration and CIM status blocks in one telegram. This is not possible since there are unused addresses between the blocks.	• Avoid reading or writing invalid data addresses. • Ensure that register X is addressed as X - 1 in Modbus telegrams, according to the Modbus standard.
4. The slave returns data value 0xFFFF (65535).	a) The value is unavailable. A data value of 0xFFFF does not necessarily indicate an error condition. It means that the value is unavailable from the Grundfos product.	See section *10. Modbus RTU commissioning, step-by-step guides* for available data.
5. The slave does not change Modbus transmission speed with register 00004.	a) Configuration error.	Set the transmission speed switches to "Software-defined". Otherwise, the value in register 00004 will be ignored by the slave.
	b) An invalid value may be set in register 00004.	See section *5.1 Setting the Modbus transmission speed* for invalid values, and set correct value in register 00004.

15.2 CIM 250

You can detect faults in CIM 250 by observing the status of the two communication LEDs. See the table below and section *3.3 Modbus GSM/GPRS, CIM 250*.

15.2.1 LED status

Fault (LED status)	Possible cause	Remedy
1. Both LED1 and LED2 remain off when the power supply is connected.	a) CIM 250 is fitted incorrectly in LC 2X1.	Ensure that CIM 250 is fitted and connected correctly.
	b) CIM 250 is defective.	Replace CIM 250.
2. LED2 for internal communication is flashing red.	a) No internal communication between CIM 250 and LC 2X1.	Ensure that CIM 250 is fitted correctly in LC 2X1.
3. LED2 for internal communication is permanently red.	a) CIM 250 does not support the connected LC 2X1.	Contact the nearest Grundfos company.
4. LED1 for GSM/GPRS communication keeps flashing yellow. See signal 1 in fig. 13 on page 12.	a) The SIM card has not been inserted in CIM 250.	Insert the SIM card. See section *6.1.2 Inserting the SIM card*.
	b) The SIM card has not been inserted correctly in CIM 250.	Insert the SIM card. See section *6.1.2 Inserting the SIM card*.
	c) The SIM card PIN code is not correct.	Enter the correct PIN code. See section *6.1.2 Inserting the SIM card*.
	d) No connection to the GSM network.	• Check the connection to the antenna. • Check the GSM coverage of the area using for example a mobile phone. • Use an external antenna and experiment with the position.
5. The LED1 for GSM/GPRS communication is pulsating yellow with single pulse, but CIM 250 cannot send or receive SMS messages.	a) CIM 250 has not been initialised.	Follow the configuration procedure in "CIM 250 SMS commands", supplement to installation and operating instructions, on the CD-ROM supplied with the GSM module.

15.2.2 CIM 250 Modbus GSM/GPRS communication faults

Fault	Possible cause	Remedy
1. The slave does not respond to telegrams.	a) Configuration or installation error.	• Ensure that CIM 250 has contact with the GSM network. The LED1 must be pulsing yellow. If the LED1 signal is incorrect, see section *6. Modbus GSM/GPRS, CIM 250 setup* for correct installation of the CIM 250. • Ensure that the correct slave address is used in the Modbus master poll. See register 00003 SoftwareDefinedModbusAddress, the factory value is 00231.
	b) The slave may be in listen-only mode.	Either send a restart communications diagnostics command, or restart the Grundfos product manually.
	c) If the holding register of address 00001 "SlaveMinimumReplyDelay" is set too high, the master may time out before receiving the response from the slave.	Increase the reply delay in the master, or reduce the "SlaveMinimumReplyDelay" in order to communicate.
2. The slave responds with exception response 0x01: "Invalid function".	a) The master is trying to use an unsupported function in CIM 250.	See section *12. Modbus function-code overview* for supported function codes. Note that reading and writing coils are not supported, so only register functions and diagnostics will be valid.
3. The slave responds with exception response 0x02: "Invalid data address".	a) The master is trying to read or write an invalid data address. If a master tries to read register addresses that are not listed in the tables, the slave will respond with this exception response. Some masters may automatically try to read large blocks in one telegram, which will cause problems if some of the registers in the block are not supported. An example would be reading the CIM configuration and CIM status register blocks in one telegram. This is not possible since there are unused addresses among the blocks.	Avoid reading or writing invalid data addresses. Ensure that register X is addressed as X - 1 in Modbus telegrams, according to the Modbus standard.
4. The slave returns data value 0xFFFF (65535).	a) The availability of data will in some cases depend on a configuration or the actual conditions of the system. For example trying to request data from a Grundfos product which is not present will return "data not available" (0xFFFF)).	See section *10. Modbus RTU commissioning, step-by-step guides* for available data.
5. The slave does not react to control actions or to writing of settings.	a) CIM 250 is SCADA PIN-code-protected (GeneralStatus register 00029, bit 0 = 1), and an incorrect PIN code has been written.	Write access requires a correct PIN code (ScadaPinCode, register 00011). Writing the correct PIN code value triggers the write access control, and write access is open, which can be verified with GeneralStatus, register 00029, bit 1 = 1.

15.3 CIM 500

You can detect faults in CIM 500 by observing the status of the two communication LEDs. See the table below and section *4.4 CIM 500 Modbus TCP*.

15.3.1 LED status

Fault (LED status)	Possible cause	Remedy
1. Both LED1 and LED2 remain off when the power supply is connected.	a) CIM 500 is fitted incorrectly in LC 2X1.	Ensure that CIM 500 is fitted and connected correctly.
	b) CIM 500 is defective.	Replace CIM 500.
2. LED2 for internal communication is flashing red.	a) No internal communication between CIM 500 and the Grundfos product.	Check that CIM 500 is fitted correctly in the Grundfos product.
3. LED2 for internal communication is permanently red.	a) CIM 500 does not support the Grundfos product connected.	Contact the nearest Grundfos company.
4. The ethernet LED1 is permanently red.	a) Fault in the CIM 500 Modbus TCP configuration.	Check that the rotary switch SW1 is set to 1. Check that Modbus TCP IP address configuration is correct. See section *A.4 Modbus TCP configuration* on page 54.
5. LED1 is permanently red and green at the same time.	a) Error in firmware download.	Use the webserver to download the firmware again.
6. LED2 is permanently red and green at the same time.	a) Memory fault.	Replace CIM 500.

15.3.2 CIM 500 Modbus TCP communication faults

Fault	Possible cause	Remedy
1. The slave does not respond to telegrams	a) Configuration or wiring error	• Check the visual diagnostics on the Modbus slave. Normal conditions are that the Grundfos GENIbus LED2 is permanently green and that the Modbus TCP LED1 is off or flashing green. If this is not fulfilled, see section *15.3.1 LED status*. • Ensure that the cable between the Modbus TCP master and the Modbus slave is connected correctly. See section *7.1 Connecting the ethernet cable*. • Ensure that the slave IP address is configured correctly, and that the correct slave IP address is used in the Modbus master poll. See section *7.3 Setting the IP addresses*.
2. The slave responds with exception response 0x01 "Invalid function"	a) The master is trying to use an unsupported function in CIM 500.	See section 8. Modbus function code overview for supported function codes. Note that reading and writing coils are not supported, so only register functions and diagnostics are valid.
3. The slave responds with exception response 0x02 "Invalid data address"	a) The master is trying to read or write an invalid data address. If a master tries to read register addresses that are not listed in the tables, the slave will respond with this exception response. Some masters may automatically try to read large blocks in one telegram, which will cause problems if some of the registers in the block are not supported. An example would be reading the CIM configuration and CIM status blocks in one telegram: this is not possible since there are unused addresses between the blocks.	Avoid reading or writing invalid data addresses. Ensure that a block of registers starting at address X is addressed as X - 1 in Modbus telegrams, according to the Modbus standard.
4. The slave returns data value 0xFFFF (65535)	a) The value is unavailable. A data value of 0xFFFF does not necessarily indicate an error condition. It means that the value is unavailable from the Grundfos product.	See section *10. Modbus RTU commissioning, step-by-step guides* for available data.

16. Modbus RTU rotary switch addresses

Modbus address	SW6	SW7	Modbus address	SW6	SW7	Modbus address	SW6	SW7	Modbus address	SW6	SW7	Modbus address	SW6	SW7
1	0	1	51	3	3	101	6	5	151	9	7	201	C	9
2	0	2	52	3	4	102	6	6	152	9	8	202	C	A
3	0	3	53	3	5	103	6	7	153	9	9	203	C	B
4	0	4	54	3	6	104	6	8	154	9	A	204	C	C
5	0	5	55	3	7	105	6	9	155	9	B	205	C	D
6	0	6	56	3	8	106	6	A	156	9	C	206	C	E
7	0	7	57	3	9	107	6	B	157	9	D	207	C	F
8	0	8	58	3	A	108	6	C	158	9	E	208	D	0
9	0	9	59	3	B	109	6	D	159	9	F	209	D	1
10	0	A	60	3	C	110	6	E	160	A	0	210	D	2
11	0	B	61	3	D	111	6	F	161	A	1	211	D	3
12	0	C	62	3	E	112	7	0	162	A	2	212	D	4
13	0	D	63	3	F	113	7	1	163	A	3	213	D	5
14	0	E	64	4	0	114	7	2	164	A	4	214	D	6
15	0	F	65	4	1	115	7	3	165	A	5	215	D	7
16	1	0	66	4	2	116	7	4	166	A	6	216	D	8
17	1	1	67	4	3	117	7	5	167	A	7	217	D	9
18	1	2	68	4	4	118	7	6	168	A	8	218	D	A
19	1	3	69	4	5	119	7	7	169	A	9	219	D	B
20	1	4	70	4	6	120	7	8	170	A	A	220	D	C
21	1	5	71	4	7	121	7	9	171	A	B	221	D	D
22	1	6	72	4	8	122	7	A	172	A	C	222	D	E
23	1	7	73	4	9	123	7	B	173	A	D	223	D	F
24	1	8	74	4	A	124	7	C	174	A	E	224	E	0
25	1	9	75	4	B	125	7	D	175	B	F	225	E	1
26	1	A	76	4	C	126	7	E	176	B	0	226	E	2
27	1	B	77	4	D	127	7	F	177	B	1	227	E	3
28	1	C	78	4	E	128	8	0	178	B	2	228	E	4
29	1	D	79	4	F	129	8	1	179	B	3	229	E	5
30	1	E	80	5	0	130	8	2	180	B	4	230	E	6
31	1	F	81	5	1	131	8	3	181	B	5	231	E	7
32	2	0	82	5	2	132	8	4	182	B	6	232	E	8
33	2	1	83	5	3	133	8	5	183	B	7	233	E	9
34	2	2	84	5	4	134	8	6	184	B	8	234	E	A
35	2	3	85	5	5	135	8	7	185	B	9	235	E	B
36	2	4	86	5	6	136	8	8	186	B	A	236	E	C
37	2	5	87	5	7	137	8	9	187	B	B	237	E	D
38	2	6	88	5	8	138	8	A	188	B	C	238	E	E
39	2	7	89	5	9	139	8	B	189	B	D	239	E	F
40	2	8	90	5	A	140	8	C	190	B	E	240	F	0
41	2	9	91	5	B	141	8	D	191	B	F	241	F	1
42	2	A	92	5	C	142	8	E	192	C	0	242	F	2
43	2	B	93	5	D	143	8	F	193	C	1	243	F	3
44	2	C	94	5	E	144	9	0	194	C	2	244	F	4
45	2	D	95	5	F	145	9	1	195	C	3	245	F	5
46	2	E	96	6	0	146	9	2	196	C	4	246	F	6
47	2	F	97	6	1	147	9	3	197	C	5	247	F	7
48	3	0	98	6	2	148	9	4	198	C	6			
49	3	1	99	6	3	149	9	5	199	C	7			
50	3	2	100	6	4	150	9	6	200	C	8			

Example: To set the slave address to the value 142, set the rotary switches SW6 and SW7 to "8" and "E", respectively.

Note that 0 is not a valid slave address as this is used for broadcasting.

! It is very important to ensure that two devices do not have the same address on the network. If two devices have the same address, the result will be an abnormal behaviour of the whole serial bus.

17. Grundfos alarm and warning codes

This is a complete list of alarm and warning codes for Grundfos products. For the codes supported by this product, see the alarms and warnings section.

Code	Description	Code	Description	Code	Description
1	Leakage current	36	Outlet valve leakage	71	Motor temperature 2 (Pt100, t_mo2)
2	Missing phase	37	Inlet valve leakage	72	Hardware fault, type 1
3	External fault signal	38	Vent valve defective	73	Hardware shutdown (HSD)
4	Too many restarts	39	Valve stuck or defective	74	Internal supply voltage too high
5	Regenerative braking	40	Undervoltage	75	Internal supply voltage too low
6	Mains fault	41	Undervoltage transient	76	Internal communication fault
7	Too many hardware shutdowns	42	Cut-in fault (dV/dt)	77	Communication fault, twin-head pump
8	PWM switching frequency reduced	43	-	78	Fault, speed plug
9	Phase sequence reversal	44	-	79	Functional fault, add-on module
10	Communication fault, pump	45	Voltage asymmetry	80	Hardware fault, type 2
11	Water-in-oil fault (motor oil)	46	-	81	Verification error, data area (RAM)
12	Time for service (general service information)	47	-	82	Verification error, code area (ROM, FLASH)
13	Moisture alarm, analog	48	Overload	83	Verification error, FE parameter area (EEPROM)
14	Electronic DC-link protection activated (ERP)	49	Overcurrent (i_line, i_dc, i_mo)	84	Memory access error
15	Communication fault, main system (SCADA)	50	Motor protection function, general shutdown (MPF)	85	Verification error, BE parameter area (EEPROM)
16	Other	51	Blocked motor or pump	86	Fault (add-on) I/O module
17	Performance requirement cannot be met	52	Motor slip high	87	-
18	Commanded alarm standby (trip)	53	Stalled motor	88	Sensor fault
19	Diaphragm break (dosing pump)	54	Motor protection function, 3 sec. limit	89	Signal fault, (feedback) sensor 1
20	Insulation resistance low	55	Motor current protection activated (MCP)	90	Signal fault, speed sensor
21	Too many starts per hour	56	Underload	91	Signal fault, temperature sensor 1
22	Moisture switch alarm, digital	57	Dry running	92	Calibration fault, (feedback) sensor
23	Smart trim gap alarm	58	Low flow	93	Signal fault, sensor 2
24	Vibration	59	No flow	94	Limit exceeded, sensor 1
25	Setup conflict	60	Low input power	95	Limit exceeded, sensor 2
26	Load continues even if the motor has been switched off	61	-	96	Setpoint signal outside range
27	External motor protector activated (for example MP 204)	62	-	97	Signal fault, setpoint input
28	Battery low	63	-	98	Signal fault, input for setpoint influence
29	Turbine operation (impellers forced backwards)	64	-	99	Signal fault, input for analog setpoint
30	Change bearings (specific service information)	65	Motor temperature 1 (t_m or t_mo or t_mo1)	100	RTC time synchronisation with GSM occured
31	Change varistor(s) (specific service information)	66	Temperature, control electronics (t_e)	101	-
32	Overvoltage	67	Temperature too high, internal frequency converter module (t_m)	102	Dosing pump not ready
33	Soon time for service (general service information)	68	External temperature or water temperature (t_w)	103	Emergency stop
34	No priming water	69	Thermal relay 1 in motor, for example Klixon	104	Software shutdown
35	Gas in pump head, deaerating problem	70	Thermal relay 2 in motor, for example thermistor	105	Electronic rectifier protection activated (ERP)

Code	Description	Code	Description	Code	Description
106	Electronic inverter protection activated (EIP)	141	-	176	Signal fault, temperature sensor 3 (t_mo3)
107	-	142	-	177	Signal fault, Smart trim gap sensor
108	-	143	-	178	Signal fault, vibration sensor
109	-	144	Motor temperature 3 (Pt100, t_mo3)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing
110	Skew load, electrical asymmetry	145	Bearing temperature high (Pt100), in general or top bearing	180	Signal fault, bearing temperature sensor (Pt100), middle bearing
111	Current asymmetry	146	Bearing temperature high (Pt100), middle bearing	181	Signal fault, PTC sensor (short circuited)
1112	Cosφ too high	147	Bearing temperature high (Pt100), bottom bearing	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing
113	Cosφ too low	148	Motor bearing temperature high (Pt100) in drive end (DE)	183	Signal fault, extra temperature sensor
114	Motor heater function activated (frost protection)	149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	184	Signal fault, general-purpose sensor
115	Too many grinder reversals or grinder reversal attempt failed	150	Fault (add-on) pump module	185	Unknown sensor type
116	Grinder motor overtemperature	151	Fault, display (HMI)	186	Signal fault, power meter sensor
117	Intrusion (door opened)	152	Communication fault, add-on module	187	Signal fault, energy meter
118	Signal fault, hydrogen sulfide H2S sensor	153	Fault, analog output	188	Signal fault, user-defined sensor
119	Signal fault, analog input AI4	154	Communication fault, display	189	Signal fault, level sensor
120	Auxiliary winding fault (single phase motors)	155	Inrush fault	190	Limit exceeded, sensor 1 (for example alarm level in WW application)
121	Auxiliary winding current too high (single-phase motors)	156	Communication fault, internal frequency converter module	191	Limit exceeded, sensor 2 (for example high level in WW application)
122	Auxiliary winding current too low (single-phase motors)	157	Real-time clock out of order	192	Limit exceeded, sensor 3 (for example overflow level in WW application)
123	Start capacitor, low (single-phase motors)	158	Hardware circuit measurement fault	193	Limit exceeded, sensor 4 (for example low level in WW/tank filling application)
124	Run capacitor, low (single-phase motors)	159	CIM fault (Communication Interface Module)	194	Limit exceeded, sensor 5
125	Signal fault, outdoor temperature sensor	160	GSM modem, SIM card fault	195	Limit exceeded, sensor 6
126	Signal fault, air temperature sensor	161	Sensor supply fault, 5 V	196	Operation with reduced efficiency
127	Signal fault, shunt relative pressure sensor	162	Sensor supply fault, 24 V	197	Operation with reduced pressure
128	Strainer clogged	163	Measurement fault, motor protection	198	Operation with increased power consumption
129	-	164	Signal fault, LiqTec sensor	199	Process out of range (monitoring, estimation, calculation, control)
130	-	165	Signal fault, analog input 1	200	Application alarm
131	-	166	Signal fault, analog input 2	201	External sensor input high
132	-	167	Signal fault, analog input 3	202	External sensor input low
133	-	168	Signal fault, pressure sensor	203	Alarm on all pumps
134	-	169	Signal fault, flow sensor	204	Inconsistency between sensors
135	-	170	Signal fault, water-in-oil (WIO) sensor	205	Level float switch sequence inconsistency
136	-	171	Signal fault, moisture sensor	206	Water shortage, level 1
137	-	172	Signal fault, atmospheric pressure sensor	207	Water leakage
138	-	173	Signal fault, rotor position sensor (Hall sensor)	208	Cavitation
139	-	174	Signal fault, rotor origo sensor	209	Non-return valve fault
140	-	175	Signal fault, temperature sensor 2 (t_mo2)	210	High pressure

| Code	Description	Code	Description	Code	Description
211	Low pressure	226	Communication fault, I/O module	241	Motor phase failure
212	Diaphragm tank precharge pressure out of range	227	Combi event	242	Automatic motor model recognition failed
213	VFD not ready	228	Night flow max. limit exceeded	243	Motor relay has been forced (manually operated or commanded)
214	Water shortage, level 2	229	Water on floor	244	Fault, On/Off/Auto switch
215	Soft pressure buildup time-out	230	Network alarm	245	Pump continuous runtime too long
216	Pilot pump alarm	231	Ethernet: No IP address from DHCP server	246	User-defined relay has been forced (manually operated or commanded)
217	Alarm, general-purpose sensor high	232	Ethernet: Auto-disabled due to misuse	247	Power-on notice, (device or system has been switched off)
218	Alarm, general-purpose sensor low	233	Ethernet: IP address conflict	248	Fault, battery/UPS
219	Pressure relief not adequate	234	Backup pump alarm	249	User-defined event 1
220	Fault, motor contactor feedback	235	Gas detected	250	User-defined event 2
221	Fault, mixer contactor feedback	236	Pump 1 fault	251	User-defined event 3
222	Time for service, mixer	237	Pump 2 fault	252	User-defined event 4
223	Time for service, mixer	238	Pump 3 fault	253	SMS data from DDD sensor not received within time
224	Pump fault, due to auxiliary component or general fault	239	Pump 4 fault	254	Inconsistent data model
225	Communication fault, pump module	240	Lubricate bearings (specific service information)		

Appendix

The appendix describes the parts of the CIM 500 webserver needed for the configuration of a Modbus TCP ethernet connection. For other CIM 500 webserver features, not specifically related to Modbus TCP, see the installation and operating instructions for CIM 500.

A.1 How to configure an IP address on your PC

For connecting a PC to CIM 500 via ethernet, the PC must be set to use a fixed (static) IP address belonging to the same subnetwork as CIM 500.

1. Open "Control Panel".
2. Enter "Network and Sharing Center".
3. Click "Change adapter settings".
4. Right-click and select "Properties" for the ethernet adapter. Typically "Local Area Connection".
5. Select properties for "Internet Protocol Version 4(TCP/IPv4).
6. Select the "Alternate Configuration" tab.
7. Configure an IP address and subnet mask to be used by your PC. See fig. 1.
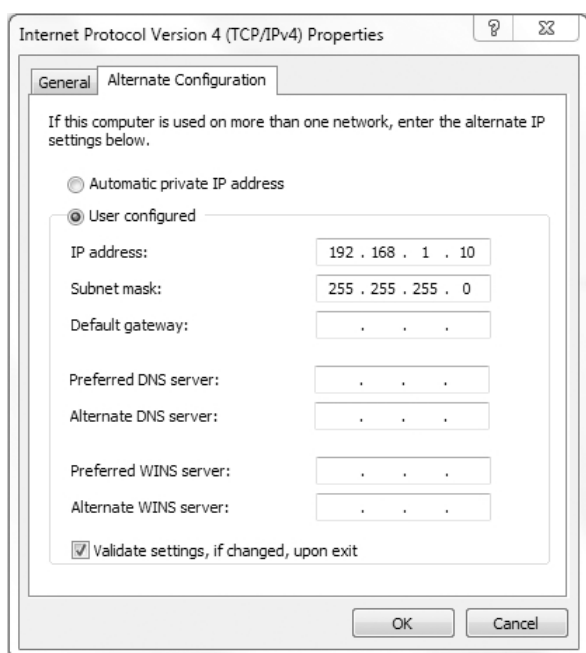
Fig. 1 Example from Windows

A.2 Webserver configuration

The built-in webserver is an easy and effective way to monitor the status of CIM 500 and configure the available functions and Industrial Ethernet protocols. The webserver also makes it possible to update the firmware of CIM 500, and store or restore settings.

To establish a connection from a PC to CIM 500, proceed as follows:

Before configuration

• Check that the PC and CIM 500 are connected via an ethernet cable.
• Check that the PC ethernet port is set to the same network as CIM 500. For network configuration, see section *A.1 How to configure an IP address on your PC*.

To establish a connection from a PC to CIM 500 for the first time, the following steps are required:

1. Open a standard internet browser and type 192.168.1.100 in the URL address field.
2. Log in to the webserver.

A.3 Login

Fig. 2 Login

User name	Enter user name. Default: admin.
Password	Enter password. Default: Grundfos.

💡 User name and password can be changed on the webserver under "User Management".

A.4 Modbus TCP configuration

Fig. 3 Real Time Ethernet Protocol Configuration - Modbus TCP

Object	Description
TCP Port Number	The default value is 502, the official IANA-assigned Modbus TCP port number. Number 502 will always be active implicitly. If you select another value in the webserver configuration field, both the new value and value 502 will be active.
IP Address	The static IP address for CIM 500 on the Modbus TCP network.
Subnet Mask	The subnet mask for CIM 500 on the Modbus TCP network.
Gateway	The default gateway for the Modbus TCP network.
Use DHCP	CIM 500 can be configured to automatically obtain the IP address from a DHCP server on the network.

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