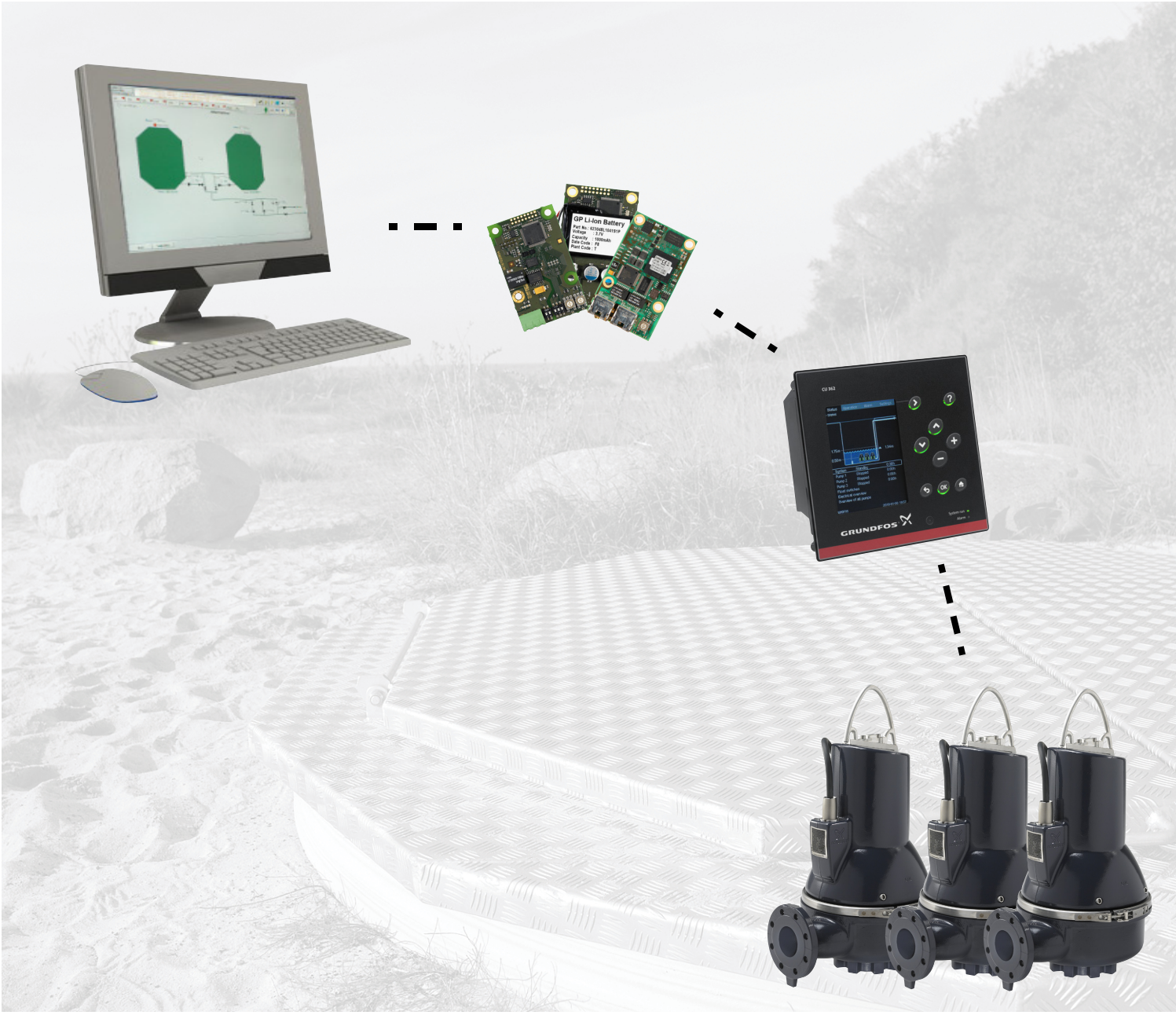
Modbus for Dedicated Controls

CIM 200 Modbus RTU
CIM 250 GSM/GPRS
CIM 500 Ethernet for Modbus TCP

Functional profile and user manual



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Original functional profile and user manual.

CONTENTS

1. Symbols used in this document

Warning

If these safety instructions are not observed, it may result in personal injury.

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

Note ***Notes or instructions that make the job easier and ensure safe operation.***

2. Introduction

2.1 About this functional profile

This functional profile describes the:

- CIM 200 Modbus RTU
- CIM250 Modbus GSM/GPRS
- CIM 500 Modbus Ethernet for Modbus TCP

for the following Grundfos products:

- Grundfos Dedicated Controls 361
- Grundfos Dedicated Controls 362.

In the following, the two supported controllers are referred to as CU 36X.

The data in this document are subject to change without prior notice. 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	3rd-generation mobile telephony network.
4G	4th-generation mobile telephony network.
ARP	Address Resolution Protocol. Translates IP-addresses to MAC-addresses.
Auto-MDIX	Ensures that both crossover cable types and non-crossover cable types can be used.
CAT5	Ethernet cable type: Has 4 twisted pairs of wires.
CAT5e	Enhanced CAT5 cable with better performance.
CAT6	Cable with very high performance.
CIM	Communication Interface Module.
CRC	Cyclic Redundancy Check, a data error detection method.
CSD	Circuit Switched Data. Connection is established via a fixed connection (a physical circuit or a reserved data channel).
CU 36X	Grundfos control unit for Dedicated Controls (CU 361 and CU 362).
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 to achieve TCP/IP communication and internet access via GSM.
Grundfos GO	A Grundfos handheld remote control device for controlling Grundfos products via infrared or radio. Based on smart phone technology.
GSM	Global System for Mobile communications.
H	Pressure (Head).
HTTP	Hyper Text Transfer Protocol. The protocol commonly used to navigate the world wide web.
IANA	Internet Assigned Numbers Authority.
IP	Internet Protocol.
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 (CIM 250) or Ethernet (CIM 500) as basis.
MP 204	Grundfos motor protector.
PIN	Personal Identification Number (SIM cards).
Ping	Packet InterNet Groper. A software utility that tests connectivity between two TCP/IP hosts.
PUK	Personal Unblocking Key (SIM cards).
Q	Flow.
R100	Grundfos handheld infrared remote control.
SELV	Separated or Safety Extra-Low Voltage.
SELV-E	Separated or Safety Extra-Low Voltage with Earth connection.
SIM	SIM card, Subscriber Identity Module.
SMA	SubMiniature version A. Coaxial radio signal cable connection standard.
SMTP	Simple Mail Transfer Protocol
SNTP	Simple Network Time Protocol. Used for clocks synchronization between computer systems.
TCP	Transmission Control Protocol. Protocol suitable for Internet communication and Industrial Ethernet communication.
TCP/IP	Transmission Control Protocol/Internet Protocol. Protocol suitable 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

The Grundfos Dedicated Controls CU 36X control unit is connected to up to six 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.

The CIM 200/250/500 is an add-on communication module to be fitted in the CU 36X, 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 pumps and read status, measured values, logs, etc.

3.2 Modbus RTU (CIM 200)

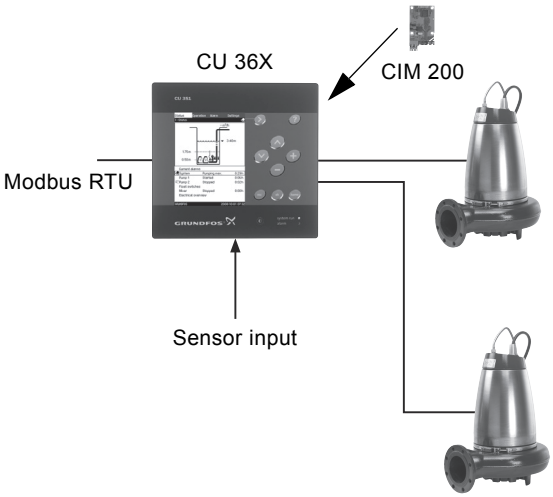

Fig. 1 CIM 200 solution for Dedicated Controls. Up to six pumps can be connected to CU 36X.

3.3 Modbus GSM/GPRS (CIM 250)

The CIM 250 is an add-on communication module to be fitted in the CU 36X, 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 pumps and read status, measured values, logs, etc.

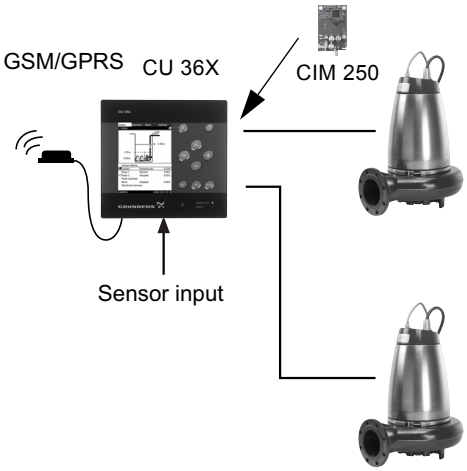

Fig. 2 CIM 250 solution for Dedicated Controls. Up to six pumps can be connected to CU 36X.

3.4 Modbus TCP (CIM 500)

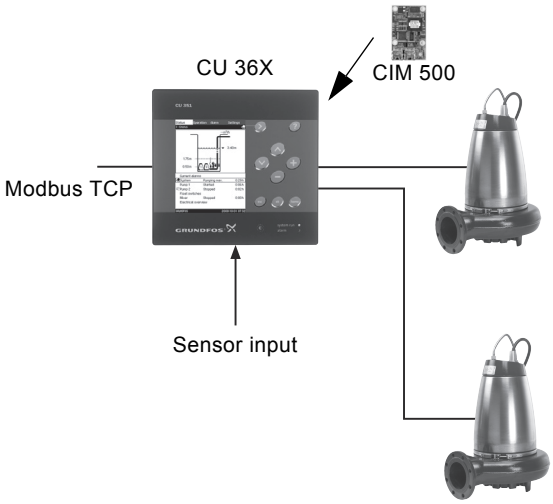

Fig. 3 CIM 500 solution for Dedicated Controls. Up to six pumps can be connected to CU 36X.

4. Specifications

4.1 CIM module general data

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

4.2 CIM 200 Modbus RTU

The table below provides an overview of the specifications for the Grundfos CIM 200. For further details, please 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 sectional cobber area	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, constantly red. See section *5.5 Status LEDs*.
Maximum number of Modbus devices	32	Using repeaters, this number can be increased. Legal address range is 1-247.
Maximum Modbus telegram size	256 bytes	Total length. Node address and CRC included. See section *12. Modbus RTU telegram examples*.

* Can only be set via software.

4.3 CIM 250 GSM/GPRS

The table below provides an overview of the specifications for the Grundfos CIM 250. For further details, please 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)	Can be changed 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. 25.

4.4 CIM 500 Modbus TCP

The table below provides an overview of the specifications for the Grundfos CIM 500 for Modbus TCP. For further details, please 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	Screened/unscreened, twisted-pair cables, 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.

5. Modbus RTU, CIM 200 setup

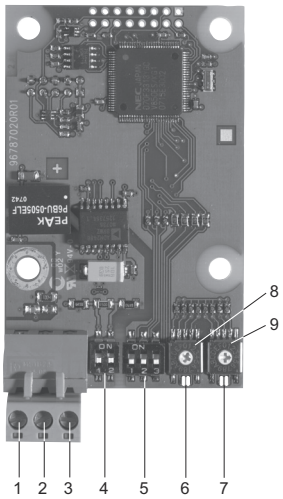

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Fig. 4 CIM 200 Modbus module

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/GND
4	SW1/SW2	On/off switches for termination resistor
5	SW3/SW4/SW5	Switches for selection of Modbus parity and transmission speed
6	LED1	Red/green status LED for Modbus communication
7	LED2	Red/green status LED for internal communication between the CIM 200 and the Grundfos product
8	SW6	Hex switch for setting the Modbus address (four most significant bits)
9	SW7	Hex switch for setting the Modbus address (four least significant bits)

A screened, twisted-pair cable must be used. The cable screen must be connected 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

The transmission speed must be set correctly before the CIM 200 Modbus module is ready to communicate with the Modbus network. DIP switches SW4 and SW5 are used for setting the transmission speed. See fig. 5.

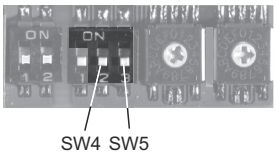

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Fig. 5 Modbus transmission speed

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 will be stored in the communication interface and will remain after a power-off.

5.2 Setting the parity

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

The parity can be set 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. The parity can be changed to no parity (2 stop bits). See fig. 6.

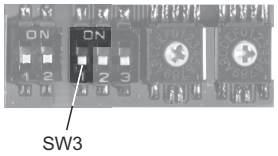

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Fig. 6 Parity

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 figures 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 will be stored in the communication interface and will remain after a power-off.

Note ***Before the parity and stop bits can be set via software-defined settings, SW4 and SW5 must be set 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, two hexadecimal rotary switches (SW6 and SW7) are used. See fig. 7.

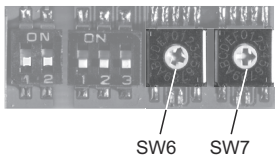

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Fig. 7 Setting the Modbus address

For a complete overview of Modbus addresses, see section *16. Fault finding*.

Note ***The Modbus address must be set decimally from 1 to 247.***

5.4 Termination resistor

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

The 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.

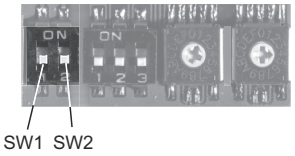

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Fig. 8 Cutting the termination resistor in and out

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

Grundfos recommends 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

Note ***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.***

Note ***All switch settings will be effective immediately after setting the values, no power-off needed.***

5.5 Status LEDs

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

- Red/green status LED (LED1) for Modbus communication
- Red/green status LED (LED2) for internal communication between the 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 the CIM 200 Modbus configuration.

LED2

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

Note ***During start-up, there may be a delay of up to 5 seconds before the LED2 status is updated.***

6. Modbus GSM/GPRS, CIM 250 setup

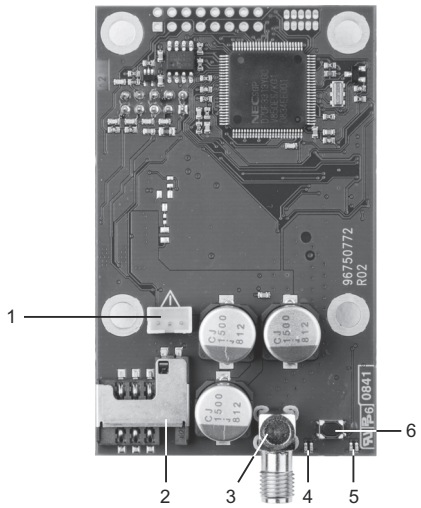

Fig. 9 CIM 250 GSM module (top-side view)

Pos.	Designation	Description
1		Battery socket
2		SIM card holder
3		SMA connection for GSM antenna
4	LED1	Yellow/green status LED for GSM/ GPRS communication
5	LED2	Red/green status LED for internal communication between the 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

Note

Before installation, 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

An antenna must be connected to the CIM 250 to establish connection to the GSM network.

Note

Grundfos offers different kinds of antennas. No antenna is supplied with the CIM 250. It must be ordered separately.

External antenna

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

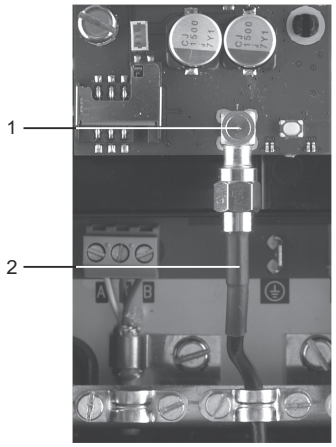

Fig. 10 Fitting an external GSM antenna

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 the 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 the CIM 250. See fig. 11.

Note

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

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

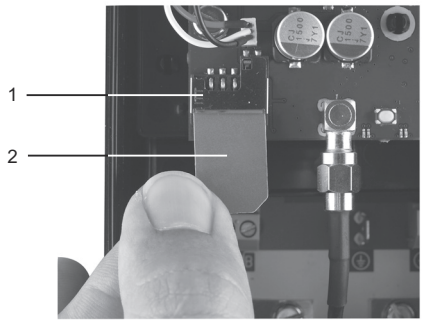

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Fig. 11 Inserting the SIM card

Pos.	Description
1	SIM card holder
2	SIM card

6.1.3 Connecting the battery and power supply

Warning

The CIM 250 must only be connected to SELV or SELV-E circuits.

Warning

The safety precautions listed below must be observed carefully as improper handling of the lithium-ion battery may result in injury or damage from electrolyte leakage, heating ignition or explosion.

These safety precautions must be observed:

- 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 should be below 45 °C.

The CIM 250 is fitted with a lithium-ion battery. It is secured by a velcro strap which absorbs vibrations and makes it easier to replace the battery. Connect the battery to the CIM 250 as shown in fig. 12.

Note

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

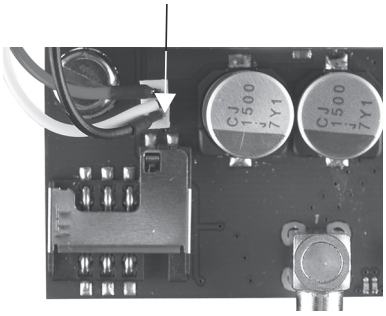

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Fig. 12 Connecting the battery

Note

The battery will only be charged if the battery temperature is within 0 °C to +45 °C.

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

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

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

6.1.4 Configuration

For software configuration of the 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/green status LED (LED1) for GSM/GPRS communication.

Red/green status LED (LED2) for internal communication between the CIM 250 and the Grundfos product.

LED1 (yellow/green)

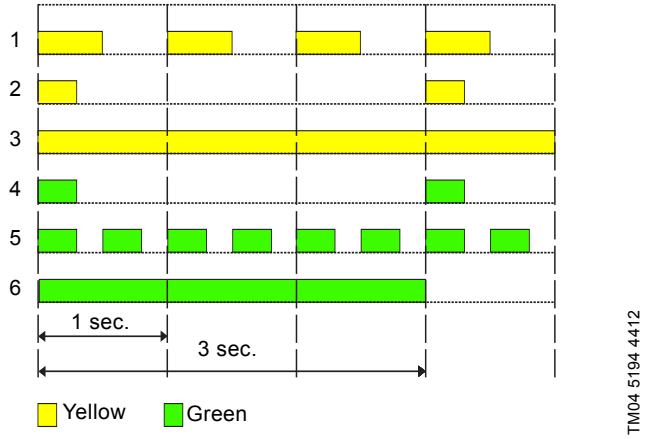

Fig. 13 LED1 status

Pos.	Status	Description
1	Flashing yellow	Searching for GSM network.
2	Pulsating yellow (single pulse)	Connection to the GSM network has been established.
3	Constantly 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 sec.)	Sending or receiving an SMS message.

LED2 (red/green)

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

7. Modbus TCP, CIM 500 setup

Warning

The CIM 500 must only be connected to SELV or SELV-E circuits.

7.1 Connecting the Ethernet cable

RJ45 plugs and Ethernet cable must be used. The cable shield must be connected to protective earth at both ends.

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

The 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.

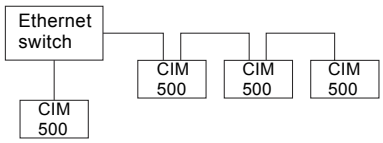

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Fig. 14 Example of Industrial Ethernet network

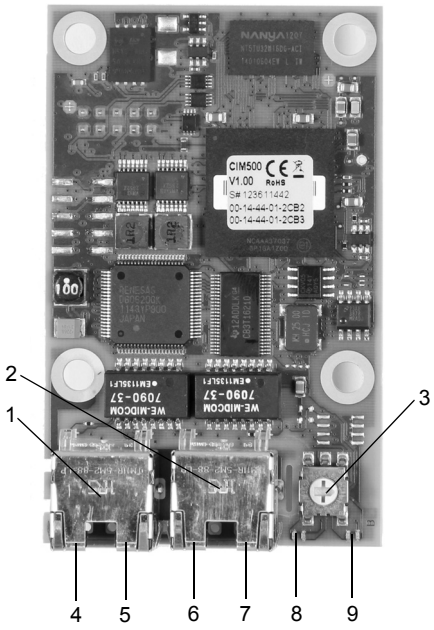

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Fig. 15 Example of Ethernet connection

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/red status LED for Ethernet communication	LED 1
9	Green/red status LED for internal communication between module and 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.

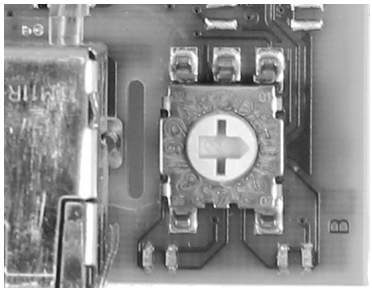

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Fig. 16 Selecting the Industrial Ethernet protocol

Pos.	Description
0	PROFINET IO (Default from factory)
1	Modbus TCP
2..E	Reserved, LED1 will be permanently red to indicate an invalid configuration
F	Reset to factory default Note: The rotary switch has to be set in this position for 20 seconds to Reset to factory default. During this period LED1 will be flashing red and green at the same time to indicate reset will occur.

Note ***Every change of the rotary switch setting, when the module is powered on, will cause the module to restart.***

7.3 Setting up the IP-addresses

The CIM 500 Ethernet module is default set up to a fixed IP address. It is possible to change the IP address settings from the built in web server.

Default IP settings used by web server	IP address:192.168.1.100 Subnet mask: 255.255.255.0 Gateway: 192.168.1.1
IP-settings for Modbus TCP	Must be setup by the Web server

7.4 Establish connection to the Web server

The CIM 500 module can be configured using the built-in Web server. To establish a connection from a PC to CIM 500 the following steps are required:

- Connect the PC and the CIM 500 module using an Ethernet cable
- Configure the PC Ethernet port to the same subnetwork as the CIM 500, e.g. 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 86.
- Open a standard Internet browser and type 192.168.1.100 in the URL field.
- Log in to the Web server using:

User	admin (factory default)
Password	Grundfos (factory default)

Note ***User and password may have been changed from their factory default values.***

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Fig. 17 CIM 500 connected to PC via Ethernet cable

For further information how to use the Web server, see section *A.2 Web server configuration* on page 86.

Note ***Both ETH1 and ETH2 can be used to establish a connection to the Web server.***

Note ***The web server can be accessed 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/green status LED (LED1) for Ethernet communication
- Red/green status LED (LED2) for internal communication between the 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 16.3.1.
Permanently red and green	Error in firmware download. See section 16.3.1.
Flashing red and green	Resetting to factory default. After 20 seconds the CIM 500 will restart.

LED2

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

Note ***During start-up, 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 RJ45 Connector.
Yellow flashing	Data communication ongoing on RJ45 Connector.
Steady yellow	Heavy network traffic on RJ45 Connector.

LINK1 and LINK2

These green LEDs shows whether the ethernet cable is properly connected.

Status	Description
Green off	No Ethernet Link on RJ45 Connector
Green on	Ethernet Link on RJ45 Connector is OK

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 *12.6 Diagnostics (0x08)* for subcodes.

Note ***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	R/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.
00501	Pump 3	R	Registers containing pump 3 data and status.
00551	Pump 4	R	Registers containing pump 4 data and status.
00601	Pump 5	R	Registers containing pump 5 data and status.
00651	Pump 6	R	Registers containing pump 6 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.
00801	Name string	R	For reading the name string from the CU 361.
02001	Hour log	R	Registers containing 72-hour logs.
06001	Event log	R	Registers containing the latest 50 event log entries.
07001	Data log index	R	Index for the configurable data log series.
07301	Data log series	R	Configurable data log series.

All addresses contain registers. Some are bit-interpreted while others are 16-bit values, or high/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, i.e. up to 10 seconds reply delay. This delay is typically used in conjunction with a radio modem. The delay value is stored in the device and will remain after a power-off. The delay set here will be added to the internal delay in the device. Default value is 0.	●	-	-
00002	RegisterOffset	Not used.	-	-	-
00003	SoftwareDefinedModbusAddress	This register holds the active Modbus address. The default value is 0xE7 (231), and there is normally no need to change this value. **Note:** For CIM 200 this value is used only when the transmission speed is set to "Software-defined" on the DIP switches SW4 and SW5. Otherwise, it will be ignored by the slave.	●	●	-
00004	SoftwareDefinedBitRate	Modbus software-defined transmission speed enumeration. The software-defined transmission speed value is stored in the device and will remain 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 the transmission speed is set to "Software-defined" on the DIP switches SW4 and SW5. Otherwise, it will be ignored by the slave.	●	-	-
00005	AutoAckControlBits	Used to select the behaviour of control bit acknowledgements from the CIM. 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].	●	●	●
00006	ReadWriteSeparation	Used to select value read-back behaviour. The value in this register is stored in the device and will remain after a power-off. 0: Register values can be written by both the Modbus master and the CIM 250 (default). 1: Read-backs are put into separate registers by the CIM 250, hence separating inputs from outputs. See section *Fig. 25 Interlocking from another controller*.	●	●	●
00007	ScadaCallBackRegister	Used to select the register in the SCADA system that will be written when a call-back request is sent via GPRS. See fig. 25.	●	●	-
00008	NoDataActivityTimeout	The elapsed time with no data activity before the module issues a "GPRS restart".	-	●	-
00009	SoftwareDefinedParity	Parity setting to be used 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 the transmission speed is set to "Software-defined" on the DIP switches SW4 and SW5. Otherwise, it will be ignored by the slave.	●	-	-
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 the transmission speed is set to "Software-defined" on the DIP switches SW4 and SW5 by selecting a value outside the range [0; 247]. Otherwise, it will be ignored by the slave.	●	-	-

Address	Register name	Description	CIM 200	CIM 250	CIM 500
00011	ScadaPinCode	PIN code for SCADA systems, etc. If GeneralStatus.ScadaPinCodeEnabled (register 00029, bit 0) is enabled, the correct PIN code must be entered in this register in order to gain access to remote control and configuration. Verify acceptance in GeneralStatus.WriteAccess (register 00029, bit 1). Programming of the SCADA PIN code made 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.	•	•	•

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. This block can be used for various kinds of fault finding.

Address	Register name	Description
00021	GENIbusCRCErrorCnt	Holds a CRC error counter for the GENIbus connection between CIM and CU 36X.
00022	GENIbusDataErrorCnt	Holds a CRC error counter for the GENIbus connection between CIM and CU 36X.
00023	VersionNumber	A Grundfos-specific version number. This is an unsigned integer value.
00024	ActualModbusAddress	Holds the current Modbus slave address of the device. Valid value range: 1…247.Note: not used for CIM 500.
00025 00026	GENIbusTXcountHI GENIbusTXcountLO	Holds a transmit counter for total number of telegrams sent to the CU 36X on the GENIbus connection.
00027 00028	GENIbusRXcountHI GENIbusRXcountLO	Holds a receive counter for total number of telegrams received from the CU 36X 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.
00031	UnitType	Grundfos product type.
00032	UnitVersion	Grundfos product version.

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.

Address	Register name	Scale	Description
00101	PitControl Bit 0: ResetAlarm	bool	Control bit that resets alarms and warnings from the CU 36X. 0 = No resetting 1 = Resetting alarm. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
	PitControl Bit 1: RESERVED	-	-
	PitControl Bit 2: ResetEventLog	bool	Control bit that resets the SCADA event log in the CU 36X. 0 = No resetting 1 = Resetting event log. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
	PitControl Bit 3: InterlockPit	bool	Control bit that interlocks the pit (stops all pumps) for a specified time interval (see the InterlockTimeout register 00226), meaning that the pit will automatically go back to "Auto" mode after timeout. 0 = No command 1 = Pit interlocked (status is read from OperatingMode register 00203). This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
	PitControl Bit 4: AutoPit	bool	Control bit that sets the pit to "Auto" mode. 0 = No command 1 = Pit in "Auto" mode (status is read from OperatingMode register 00203). This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
	PitControl Bit 5: CallBackAck	bool	Control bit that acknowledges a call-back from the CU 36X. 0: No command 1: Acknowledging the call-back. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
	PitControl Bit 6: ResetUserDefCounter1	bool	Reset the user-defined counter 1 0: No resetting 1: Reset counter
	PitControl Bit 7: ResetUserDefCounter2	bool	Reset the user-defined counter 2 0: No resetting 1: Reset counter
	PitControl Bit 8: ResetUserDefCounter3	bool	Reset the user-defined counter 3 0: No resetting 1: Reset counter
	PitControl Bit 9: CallBackTest	bool	Activates the call-back test function 0: No command 1: Activates call-back test
00102	RelayControl Bit 0: SetCustomRelay	bool	Control bit that sets the value of the custom relay. 0 = Relay state logical 0 1 = Relay state logical 1.
	CustomRelayPulse Bit 1: PulseRelay	bool	Control bit that pulses the custom relay. 0 (no pulse) will be the resulting state. 0 = No pulse 1 = Pulse.
00103	PitPump1Control	enum	Remote manual control of pump 1. 0 = "Auto" mode (the pump is controlled by the CU 36X) 1 = Forced start 2 = Forced stop.
00104	PitPump2Control	enum	Remote manual control of pump 2. 0 = "Auto" mode (the pump is controlled by the CU 36X) 1 = Forced start 2 = Forced stop.

Address	Register name	Scale	Description
00105	PitPump3Control	enum	Remote manual control of pump 3. 0 = "Auto" mode (the pump is controlled by the CU 36X) 1 = Forced start 2 = Forced stop.
00106	PitPump4Control	enum	Remote manual control of pump 4. 0 = "Auto" mode (the pump is controlled by the CU 36X) 1 = Forced start 2 = Forced stop.
00107	PitPump5Control	enum	Remote manual control of pump 5. 0 = "Auto" mode (the pump is controlled by the CU 36X) 1 = Forced start 2 = Forced stop.
00108	PitPump6Control	enum	Remote manual control of pump 6. 0 = "Auto" mode (the pump is controlled by the CU 36X) 1 = Forced start 2 = Forced stop.
00109	ScadaPinCode	unscaled	PIN code for SCADA systems, etc. If PitStatus.ScadaPinCodeEnabled (register 00202, bit 4) is enabled, the correct PIN code must be set in this register in order to gain access to remote control and configuration. Verify acceptance in PitStatus.WriteAccess (register 00202, bit 5).
00110	SetEventLogClearID	unscaled	Selects which records to clear in the event log.
00111	SetInterlockTimeout	1 min.	Interlock timeout value measured in minutes. Status of this register is read in InterlockTimeout (register 00226).
00112	SetRealTimeClockHI	1 second	Setting the real-time clock in the CU 36X in seconds since midnight January 1st 1970 (UNIX time). First set SetRealTimeClockHI, then SetRealTimeClockLO in order to set a new time in UNIX format.
00113	SetRealTimeClockLO		
00114	SetRtcSecond	1 second	Real-time clock: Second of the minute [0; 59].
00115	SetRtcMinute	1 min.	Real-time clock: Minute of the hour [0; 59].
00116	SetRtcHour	1 hour	Real-time clock: Hour of the day [0; 23].
00117	SetRtcDay	1 day	Real-time clock: Day of the month [1; 31].
00118	SetRtcMonth	1 month	Real-time clock: Month of the year [1; 12].
00119	SetRtcYear	1 year	Real-time clock: Year [0; 254] = [year 2000; year 2254].
00120	SetRtc Bit0: SetRtc	bool	Control bit that sets the new real-time clock in the CU 36X. 1 = Set new real-time clock from the registers 00114 to 00119. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section *9.2 CIM configuration register block*, address 00005, for acknowledgement behaviour.
00121	SetOverflowLevel	0.01 m	Setting a new level for activation of overflow level alarm. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00122	SetHighLevel	0.01 m	Setting a new level for activation of high-level alarm. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00123	SetAlarmLevel	0.01 m	Setting a new level for activation of alarm level alarm. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00124	SetDryRunningLevel	0.01 m	Setting a new level for activation of dry-running alarm. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00125	SetFoamDrainingLevel	0.01 m	Setting a new level for foam-draining stop. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00126	SetStartLevelPump1	0.01 m	Setting a new start level, pump 1. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00127	SetStopLevelPump1	0.01 m	Setting a new stop level, pump 1. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00128	SetStartLevelPump2	0.01 m	Setting a new start level, pump 2. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00129	SetStopLevelPump2	0.01 m	Setting a new stop level, pump 2. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.

Address	Register name	Scale	Description
00130	SetStartLevelPump3	0.01 m	Setting a new start level, pump 3. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00131	SetStopLevelPump3	0.01 m	Setting a new stop level, pump 3. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00132	SetStartLevelPump4	0.01 m	Setting a new start level, pump 4. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00133	SetStopLevelPump4	0.01 m	Setting a new stop level, pump 4. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00134	SetStartLevelPump5	0.01 m	Setting a new start level, pump 5. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00135	SetStopLevelPump5	0.01 m	Setting a new stop level, pump 5. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00136	SetStartLevelPump6	0.01 m	Setting a new start level, pump 6. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00137	SetStopLevelPump6	0.01 m	Setting a new stop level, pump 6. If ReadWriteSeparation (register 00006, bit 0) is set to "0", the CIM will overwrite this register value with the resulting level.
00138	SetCurrentMaxAlarmGrp1	0.01 A	Set current max. alarm for group 1
00139	SetCurrentMinAlarmGrp1	0.01 A	Set current min. alarm for group 1
00140	SetCurrentMaxWarnGrp1	0.01 A	Set current max. warning for group 1
00141	SetCurrentMinWantGrp1	0.01 A	Set current min. warning for group 1
00142	SetCurrentMaxAlarmGrp2	0.01 A	Set current max. alarm for group 2
00143	SetCurrentMinAlarmGrp2	0.01 A	Set current min. alarm for group 2
00144	SetCurrentMaxWarnGrp2	0.01 A	Set current max. warning for group 2
00145	SetCurrentMinWantGrp2	0.01 A	Set current min. warning for group 2

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.

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 1: AckSetRtc	bool	Indicates if a SetRtc (real-time clock) 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.
	AcknowledgeRegister Bit 3: AckInterlockPit	bool	Indicates if an InterlockPit 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 4: AckAutoPit	bool	Indicates if an AutoPit 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 5: AckCallBack	bool	Indicates if a CallBack 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.
	PitStatus Bit 4: ScadaPinCodeEnabled	bool	PIN code functionality. 0 = No PIN code required 1 = PIN code required to perform remote control and configuration.
	PitStatus Bit 5: WriteAccess	bool	Remote write access. 0 = No write access (PIN code is incorrect) 1 = Full write access (PIN code is either correct or not enabled).

Address	Register name	Scale	Description
00203	OperatingMode	enum	Register for reading the actual operating mode of the pit. 0 = Standby (stopped from level control) 1 = Start-up delay 2 = Pumping 3 = Stop delay 4 = Pumping max. 5 = Stopped 6 = Foam-draining 7 = Daily emptying 8 = Pump anti-seizing 9 = Manual control (all enabled pumps in manual control mode) 10 = Interlock control (the pit is interlocked) 11 = Mains supply fault 12 = Level sensor fault 13 = All enabled pumps in alarm 14 = All pumps out of operation 15 = CU 36X controller in service mode
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.
	PitPumpsPresence Bit 2: Pump3Presence	bool	Presence of pump 3. 0 = Not present 1 = Present.
	PitPumpsPresence Bit 3: Pump4Presence	bool	Presence of pump 4. 0 = Not present 1 = Present.
	PitPumpsPresence Bit 4: Pump5Presence	bool	Presence of pump 5. 0 = Not present 1 = Present.
	PitPumpsPresence Bit 5: Pump6Presence	bool	Presence of pump 6. 0 = Not present 1 = Present.
	PitPumpsPresence Bit 6: Mixer	bool	Presence of mixer 0 = Not present 1 = Present.
00205	PitPumpsDisabled Bit 0: Pump1Disabled	bool	Enabled/disabled state of pump 1. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 1: Pump2Disabled	bool	Enabled/disabled state of pump 2. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 2: Pump3Disabled	bool	Enabled/disabled state of pump 3. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 3: Pump4Disabled	bool	Enabled/disabled state of pump 4. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 4: Pump5Disabled	bool	Enabled/disabled state of pump 5. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 5: Pump6Disabled	bool	Enabled/disabled state of pump 6. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 6: MixerDisabled	bool	Enabled/disabled state of mixer. 0 = Enabled 1 = Disabled.

Address	Register name	Scale	Description
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.
	PitPumpsRunning Bit 2: Pump3Running	bool	Running state of pump 3. 0 = Not running 1 = Running.
	PitPumpsRunning Bit 3: Pump4Running	bool	Running state of pump 4. 0 = Not running 1 = Running.
	PitPumpsRunning Bit 4: Pump5Running	bool	Running state of pump 5. 0 = Not running 1 = Running.
	PitPumpsRunning Bit 5: Pump6Running	bool	Running state of pump 6. 0 = Not running 1 = Running.
	PitPumpsRunning Bit 6: MixerRunning	bool	Running state of mixer. 0 = Not running 1 = Running.
00207	PitPumpsMonitoringFault Bit 0: Pump1MonitoringFault	bool	Fault state of pump 1 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 1: Pump2MonitoringFault	bool	Fault state of pump 2 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 2: Pump3MonitoringFault	bool	Fault state of pump 3 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 3: Pump4MonitoringFault	bool	Fault state of pump 4 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 4: Pump5MonitoringFault	bool	Fault state of pump 5 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 5: Pump6MonitoringFault	bool	Fault state of pump 6 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 6: MixerMonitoringFault	bool	Monitoring fault on mixer 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.
	PitPumpsWarning Bit 2: Pump3Warning	bool	Warning state of pump 3. 0 = No warning 1 = Warning.
	PitPumpsWarning Bit 3: Pump4Warning	bool	Warning state of pump 4. 0 = No warning 1 = Warning.
	PitPumpsWarning Bit 4: Pump5Warning	bool	Warning state of pump 5. 0 = No warning 1 = Warning.
	PitPumpsWarning Bit 5: Pump6Warning	bool	Warning state of pump 6. 0 = No warning 1 = Warning.
	PitPumpsWarning Bit 6: MixerWarning	bool	Warning state of mixer. 0 = No warning 1 = Warning.

Address	Register name	Scale	Description
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.
	PitPumpsAlarm Bit 2: Pump3Alarm	bool	Alarm state of pump 3. 0 = No alarm 1 = Alarm.
	PitPumpsAlarm Bit 3: Pump4Alarm	bool	Alarm state of pump 4. 0 = No alarm 1 = Alarm.
	PitPumpsAlarm Bit 4: Pump5Alarm	bool	Alarm state of pump 5. 0 = No alarm 1 = Alarm.
	PitPumpsAlarm Bit 5: Pump6Alarm	bool	Alarm state of pump 6. 0 = No alarm 1 = Alarm.
	PitPumpsAlarm Bit 6: MixerAlarm	bool	Alarm state of mixer. 0 = No alarm 1 = Alarm.
00210	PitAlarms1	bits	Pit alarm events, item 1. Bit-interpreted. See section *Fig. 25 Interlocking from another controller*.
00211	PitAlarms2	bits	Pit alarm events, item 2. Bit-interpreted. See section *Fig. 25 Interlocking from another controller*.
00212	PitAlarms3 Bit 0: DischargePressureSignalFault	bool	Discharge pressure sensor signal fault 0 = No Alarm 1 = Alarm present
	PitAlarms3 Bit 1: WaterOnFloor	bool	Water on floor alarm 0 = No Alarm 1 = Alarm present
	PitAlarms3 Bit 2: GasDetected	bool	Gas detected alarm 0 = No Alarm 1 = Alarm present
	PitAlarms3 Bit 3: UserEvent1	bool	User event 1 alarm 0 = No Alarm 1 = Alarm present
	PitAlarms3 Bit 4: UserEvent2	bool	User event 2 alarm 0 = No Alarm 1 = Alarm present
	PitAlarms3 Bit 5: UserEvent3	bool	User event 3 alarm 0 = No Alarm 1 = Alarm present
	PitAlarms3 Bit 6: UserEvent4	bool	User event 4 alarm 0 = No Alarm 1 = Alarm present
00213	PitWarnings1	bits	Pit warning events, item 1. Bit-interpreted. See fig. 25.
00214	PitWarnings2	bits	Pit warning events, item 2. Bit-interpreted. See fig. 25.

Address	Register name	Scale	Description
00215	PitWarnings3 Bit 0: DischargePressureSignalFault	bool	Discharge pressure sensor signal fault 0 = No warning 1 = Warning present
	PitWarnings3 Bit 1: WaterOnFloor	bool	Water on floor warning 0 = No warning 1 = Warning present
	PitWarnings3 Bit 2: GasDetected	bool	Gas detected warning 0 = No warning 1 = Warning present
	PitWarnings3 Bit 3: UserEvent1	bool	User event 1 warning 0 = No warning 1 = Warning present
	PitWarnings3 Bit 4: UserEvent2	bool	User event 2 warning 0 = No warning 1 = Warning present
	PitWarnings3 Bit 5: UserEvent3	bool	User event 3 warning 0 = No warning 1 = Warning present
	PitWarnings3 Bit 6: UserEvent4	bool	User event 4 warning 0 = No warning 1 = Warning present
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/off state of float switch 1 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 1: FloatSwitch2Status	bool	On/off state of float switch 2 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 2: FloatSwitch3Status	bool	On/off state of float switch 3 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 3: FloatSwitch4Status	bool	On/off state of float switch 4 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 4: FloatSwitch5Status	bool	On/off state of float switch 5 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 5: ExtraOverflowSwitch	bool	On/off state of extra overflow float switch (if installed). 0 = Off 1 = On.
00219	FloatSwitch1Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = - 3 = Stop of all pumps 4 = Stop 5 = Stop of first pump 6 = Stop of second pump 11 = Start/stop 12 = Start of first pump/stop 13 = Start 14 = Start of first pump 15 = Start of second pump 20 = Start of all pumps 21 = Alarm level 23 = High level.

Address	Register name	Scale	Description
00220	FloatSwitch2Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = - 3 = Stop of all pumps 4 = Stop 5 = Stop of first pump 6 = Stop of second pump 11 = Start/stop 12 = Start of first pump/stop 13 = Start 14 = Start of first pump 15 = Start of second pump 20 = Start of all pumps 21 = Alarm level 23 = High level.
00221	FloatSwitch3Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = - 3 = Stop of all pumps 4 = Stop 5 = Stop of first pump 6 = Stop of second pump 11 = Start/stop 12 = Start of first pump/stop 13 = Start 14 = Start of first pump 15 = Start of second pump 20 = Start of all pumps 21 = Alarm level 23 = High level.
00222	FloatSwitch4Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = - 3 = Stop of all pumps 4 = Stop 5 = Stop of first pump 6 = Stop of second pump 11 = Start/stop 12 = Start of first pump/stop 13 = Start 14 = Start of first pump 15 = Start of second pump 20 = Start of all pumps 21 = Alarm level 23 = High level.
00223	FloatSwitch5Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = - 3 = Stop of all pumps 4 = Stop 5 = Stop of first pump 6 = Stop of second pump 11 = Start/stop 12 = Start of first pump/stop 13 = Start 14 = Start of first pump 15 = Start of second pump 20 = Start of all pumps 21 = Alarm level 23 = High level.

Address	Register name	Scale	Description
00224	PitSensors Bits 0: UltrasonicLevelControlSensor	bool	Presence of ultrasonic level control sensor. 0 = Not present 1 = Present.
	PitSensors Bits 1: PressureSensor	bool	Presence of pressure sensor. 0 = Not present 1 = Present.
	PitSensors Bits 2: FloatSwitches	bool	Presence of float switches. 0 = Not present 1 = Present.
	PitSensors Bit 3: FlowSensor	bool	Presence of flow sensor. 0 = Not present 1 = Present.
	PitSensors Bit 4: Power/EnergySensor	bool	Presence of power or energy sensor. 0 = Not present 1 = Present.
	PitSensors Bit 5: UserDefinedSensor1	bool	Presence of user-defined sensor, analog input 1. 0 = Not present 1 = Present.
	PitSensors Bit 6: UserDefinedSensor2	bool	Presence of user-defined sensor, analog input 2. 0 = Not present 1 = Present.
	PitSensors Bit 7: UserDefinedSensor3	bool	Presence of user-defined sensor, analog input 3. 0 = Not present 1 = Present.
00225	DayCounterZeroTime	enum	Zero time for today and yesterday counters. Range: 0-23 hours.
00226	InterlockTimeout	1 sec.	Actual interlock timeout value in minutes. A new value can be set in the SetInterlockTimeout (register 00111).
00227	InterlockRemainTime	1 sec.	Remaining interlock time.
00228	RealTimeClockHI	1 s	The real-time clock in the CU 361 in seconds since midnight January 1st 1970 (UNIX time). See section *11.11 Real-time clock*.
00229	RealTimeClockLO		
00230	RtcSecond	1 second	Second of the minute [0; 59]. See section *11.11 Real-time clock*.
00231	RtcMinute	1 min.	Minute of the hour [0; 59]. See section *11.11 Real-time clock*.
00232	RtcHour	1 hour	Hour of the day [0; 23]. See section *11.11 Real-time clock*.
00233	RtcDay	1 day	Day of the month [1; 31]. See section *11.11 Real-time clock*.
00234	RtcMonth	1 month	Month of the year [1; 12]. See section *11.11 Real-time clock*.
00235	RtcYear	1 year	Year [0; 254] = [year 2000; year 2254]. See section *11.11 Real-time clock*.
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.
00240	OverflowLevel	0.01 m	Level for activation of overflow level alarm.
00241	HighLevel	0.01 m	Level for activation of high-level alarm.
00242	AlarmLevel	0.01 m	Level for activation of alarm level alarm.
00243	DryRunningLevel	0.01 m	Level for activation of dry-running level alarm.
00244	FoamDrainingLevel	0.01 m	Level for foam-draining stop.
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.
00248	StopLevelPump2	0.01 m	Stop level for pump 2.
00249	StartLevelPump3	0.01 m	Start level for pump 3.
00250	StopLevelPump3	0.01 m	Stop level for pump 3.
00251	StartLevelPump4	0.01 m	Start level for pump 4.

Address	Register name	Scale	Description
00252	StopLevelPump4	0.01 m	Stop level for pump 4.
00253	StartLevelPump5	0.01 m	Start level for pump 5.
00254	StopLevelPump5	0.01 m	Stop level for pump 5.
00255	StartLevelPump6	0.01 m	Start level for pump 6.
00256	StopLevelPump6	0.01 m	Stop level for pump 6.
00257	FirstGroup2Pump	enum	First pump in group 2. 0 = - 1 = - 2 = Pump 2 3 = Pump 3 4 = Pump 4 5 = Pump 5 6 = Pump 6.
00258	BatteryVoltage	0.1 V	Voltage level on battery.
00259	IOLogic Bit 0: Output1	bool	Status of logic output 1. 0 = Off 1 = On.
	IOLogic Bit 1: Output2	bool	Status of logic output 2. 0 = Off 1 = On.
	IOLogic Bit 2: Output3	bool	Status of logic output 3. 0 = Off 1 = On.
	IOLogic Bit 3: Output4	bool	Status of logic output 4. 0 = Off 1 = On.
	IOLogic Bit 4: Output5	bool	Status of logic output 5. 0 = Off 1 = On.
	IOLogic Bit 5: Output6	bool	Status of logic output 6. 0 = Off 1 = On.
	IOLogic Bit 6: Output7	bool	Status of logic output 7. 0 = Off 1 = On.
	IOLogic Bit 7: Output8	bool	Status of logic output 8. 0 = Off 1 = On.
00260	RandomStartLevelBand	0.01 m	Random start level band (first pump only).

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. The table below shows for which CU 36X 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.
00302	PitSwitchWaterLevel	enum	Float-switch-detected water level in the pit. Requires one or more float switches. Valid range: 0-5 (0x0000 - 0x0005).
00303	PitDepth	0.01 m	Depth of the pit.
00304	PitFlowIn	0.1 litre/s	Actual flow into the pit. Requires a flow sensor or flow calculation from level sensor.
00305	PitAverageFlowIn	0.1 litre/s	Average flow into the pit. Requires a flow sensor or flow calculation from level sensor.
00306	PitFlowOut	0.1 litre/s	Actual flow out of the pit. Requires a flow sensor or flow calculation from level sensor.
00307	PitAverageFlowOut	0.1 litre/s	Average flow out of the pit. Requires a flow sensor or flow calculation from level sensor.
00308	PitPowerHI	1 W	Power consumption of the pit. Requires a power sensor or MP 204.
00309	PitPowerLO		
00310	PitEnergyHI	0.1 kWh	Energy consumption of the pit. Requires a power sensor or MP 204.
00311	PitEnergyLO		
00312	PitEnergyYesterday	0.1 kWh	Energy consumption of the pit yesterday. Requires a power sensor or MP 204.
00313	PitEnergyToday	0.1 kWh	Energy consumption of the pit today. Requires a power sensor or MP 204.
00314	PitSpecificEnergy	1 Wh/m^3	Specific energy consumption of the pit. Requires a power sensor or MP 204 and a flow sensor.
00315	PitPumpedVolumeHI	0.1 m^3	Total pumped volume. Requires a flow sensor or flow calculation from level sensor.
00316	PitPumpedVolumeLO		
00317	PitPumpedVolumeYesterday	0.1 m^3	Total pumped volume yesterday. Requires a flow sensor or flow calculation from level sensor.
00318	PitPumpedVolumeToday	0.1 m^3	Total pumped volume today. Requires a flow sensor or flow calculation from level sensor.
00319	PitMixerStartsPerHour	unscaled	Number of mixer starts per hour. Requires the presence of a mixer.
00320	PitOverflowVolume	0.1 m^3	Pit overflow volume. Requires a level sensor.
00321	PitOverflowVolumeYesterday	0.1 m^3	Pit overflow volume yesterday. Requires a level sensor.
00322	PitOverflowVolumeToday	0.1 m^3	Pit overflow volume today. Requires a level sensor.
00323	PitOverflowTime	1 min.	Pit overflow time. Requires a level sensor or float switches.
00324	PitOverflowTimeYesterday	1 min.	Pit overflow time yesterday. Requires a level sensor or float switches.
00325	PitOverflowTimeToday	1 min.	Pit overflow time today. Requires a level sensor or float switches.
00326	PitOverflowCounter	unscaled	Number of pit overflows. Requires a level sensor or float switches.
00327	PitOverflowCounterYesterday	unscaled	Number of pit overflows yesterday. Requires a level sensor or float switches.
00328	PitOverflowCounterToday	unscaled	Number of pit overflows today. Requires a level sensor or float switches.
00329	PitOperatingTimeHI	1 min.	Total pit operating time (power-on time).
00330	PitOperatingTimeLO		
00331	Pit2PumpsOprTimeHI	1 min.	Total operating time (two pumps operating simultaneously).
00332	Pit2PumpsOprTimeLO		
00333	Pit2PumpsOprTimeYesterday	1 min.	Operating time yesterday (two pumps operating simultaneously).
00334	Pit2PumpsOprTimeToday	1 min.	Operating time today (two pumps operating simultaneously).
00335	Pit3PumpsOprTimeHI	1 min.	Total operating time (three pumps operating simultaneously).
00336	Pit3PumpsOprTimeLO		
00337	Pit3PumpsOprTimeYesterday	1 min.	Operating time yesterday (three pumps operating simultaneously).
00338	Pit3PumpsOprTimeToday	1 min.	Operating time today (three pumps operating simultaneously).
00339	Pit4PumpsOprTimeHI	1 min.	Total operating time (four pumps operating simultaneously).
00340	Pit4PumpsOprTimeLO		
00341	Pit4PumpsOprTimeYesterday	1 min.	Operating time yesterday (four pumps operating simultaneously).
00342	Pit4PumpsOprTimeToday	1 min.	Operating time today (four pumps operating simultaneously).

Address	Register name	Scale	Description
00343	Pit5PumpsOprTimeHI	1 min.	Total operating time (five pumps operating simultaneously).
00344	Pit5PumpsOprTimeLO		
00345	Pit5PumpsOprTimeYesterday	1 min.	Operating time yesterday (five pumps operating simultaneously).
00346	Pit5PumpsOprTimeToday	1 min.	Operating time today (five pumps operating simultaneously).
00347	Pit6PumpsOprTimeHI	1 min.	Total operating time (six pumps operating simultaneously).
00348	Pit6PumpsOprTimeLO		
00349	Pit6PumpsOprTimeYesterday	1 min.	Operating time yesterday (six pumps operating simultaneously).
00350	Pit6PumpsOprTimeToday	1 min.	Operating time today (six pumps operating simultaneously).
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.
00354	Pit0PumpsOprTimeHI	1 min.	Total operating time (no pumps operating).
00355	Pit0PumpsOprTimeLO		
00356	Pit0PumpsOprTimeYesterday	1 min.	Operating time yesterday (no pumps operating).
00357	Pit0PumpsOprTimeToday	1 min.	Operating time today (no pumps operating).
00358	Pit1PumpsOprTimeHI	1 min.	Total operating time (one pump operating).
00359	Pit1PumpsOprTimeLO		
00360	Pit1PumpsOprTimeYesterday	1 min.	Operating time yesterday (one pump operating).
00361	Pit1PumpsOprTimeToday	1 min.	Operating time today (one pump operating).
00362	MixerRuntime	1 min.	Runtime for mixer.
00363	MixerStartCounter	unscaled	Start counter for mixer.
00364	UserDefCounter1	unscaled	User-defined counter 1
00365	UserDefCounter2	unscaled	User-defined counter 2
00366	UserDefCounter3	unscaled	User-defined counter 3
00367	PitOutletPressure	0.001 bar	Outlet pressure of the pit

9.7 Pump 1 register block

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

Address	Register name	Scale	Description
00401	Pump1Status Bit 0: Presence	bool	Presence of pump. 0 = Not present 1 = Present.
	Pump1Status Bit 1: Running	bool	Running state of pump. 0 = Not running 1 = Running.
	Pump1Status Bit 2: MonitoringFault	bool	Fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump1Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump1Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump1Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump1Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump1Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump1Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump1Status Bit 9: CUEPresent	bool	Presence of auxiliary equipment CUE. 0 = Not present 1 = Present.
	Pump1Status Bit 10: CUEFault	bool	Fault state of auxiliary equipment CUE. 0 = No fault 1 = Fault.
	Pump1Status Bit 11: PumpDisabled	bool	Enabled/disabled state of pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00402	Pump1ControlSource	enum	Control source of pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00403	Pump1ConnectionType	enum	Pump connection type. 0 = The pump is controlled from the CU 36X output relay. 1 = The pump is controlled from the IO 351B output relay. 2 = The pump is controlled from the CU 36X and VFD. 3 = The pump is controlled from the IO 351B and VFD.
00404	Pump1OperatingTimeHI	1 min.	Total operating time.
00405	Pump1OperatingTimeLO		
00406	Pump1TimeToServiceHI	1 min.	Time to next service.
00407	Pump1TimeToServiceLO		
00408	Pump1OperatingTimeYesterday	1 min.	Operating time yesterday.
00409	Pump1OperatingTimeToday	1 min.	Operating time today.
00410	Pump1LatestOperatingTime	1 s	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.
00414	Pump1StartCounterToday	unscaled	Total number of pump starts today.
00415	Pump1StartsPerHour	unscaled	Number of pump starts within the last hour.
00416	Pump1Flow	0.1 litre/s	Calculated average or measured pump flow.
00417	Pump1LatestFlow	0.1 litre/s	Latest calculated/measured flow (capacity).
00418	Pump1Current	0.1 A	Motor current.
00419	Pump1LatestCurrent	0.1 A	Latest motor current.

Address	Register name	Scale	Description
00420	Pump1Voltage	0.1 V	Voltage.
00421	Pump1Insulation	10 kΩ	Motor insulation resistance.
00422	Pump1WaterInOil	0.1 %	Motor water-in-oil measurement.
00423	Pump1Alarms1	bits	See section *Fig. 25 Interlocking from another controller*.
00424	Pump1Alarms2	bits	See section *Fig. 25 Interlocking from another controller*.
00425	Pump1Alarms3	bits	See section *Fig. 25 Interlocking from another controller*.
00426	Pump1Warnings1	bits	See section *Fig. 25 Interlocking from another controller*.
00427	Pump1Warnings2	bits	See section *Fig. 25 Interlocking from another controller*.
00428	Pump1Warnings3	bits	See section *Fig. 25 Interlocking from another controller*.
00429	Pump1MotorTemperature1	1 °C	Motor temperature 1.
00430	Pump1MotorTemperature2	1 °C	Motor temperature 2.
00431	Pump1PowerHI	1 W	Power consumption.
00432	Pump1PowerLO		
00433	Pump1EnergyHI	0.1 kWh	Energy consumption.
00434	Pump1EnergyLO		
00435	Pump1CosPhi	0.01	Motor cos φ.
00436	Pump1Frequency	0.1 Hz	Motor-applied frequency.
00437	Pump1VFDmode	enum	Mode of variable-frequency drive. 0 = VFD not controlled 1 = - 2 = Stopped 3 = Reverse start 4 = Start flushing 5 = Normal 6 = Run flushing 7 = Stop flushing 8 = Specific-energy test.
00438	Pump1Torque	0.1 Nm	Motor torque.
00439	Pump1iAsym	0.1 %	Line current asymmetry.
00440	Pump1Sensors.WIO Bit 0: WaterInOilSensor	bool	Presence of water-in-oil (WIO) sensor. 0 = Not present 1 = Present.
	Pump1Sensors.Current Bit 1: MotorCurrentSensor	bool	Presence of current sensor. 0 = Not present 1 = Present.
00441	Pump1Alarms4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump1Alarms4 Bit: 13	bool	Pump blocked alarm 0 = No alarm 1 = Alarm
	Pump1Alarms4 Bit 14:	bool	Power sensor signal fault alarm 0 = No alarm 1 = Alarm
00442	Pump1Warnings4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump1Warnings4 Bit 13:	bool	Pump blocked warning 0 = No warning 1 = Warning
	Pump1Warnings4 Bit 14:	bool	Power sensor signal fault warning 0 = No warning 1 = Warning
00443	Pump1AntiBlockingCounter	bits	Number of anti blockings in the pump

9.8 Pump 2 register block

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

Address	Register name	Scale	Description
00451	Pump2Status Bit 0: Presence	bool	Presence of pump. 0 = Not present 1 = Present.
	Pump2Status Bit 1: Running	bool	Running state of pump. 0 = Not running 1 = Running.
	Pump2Status Bit 2: MonitoringFault	bool	Fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump2Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump2Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump2Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump2Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump2Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump2Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump2Status Bit 9: CUEPresent	bool	Presence of auxiliary equipment CUE. 0 = Not present 1 = Present.
	Pump2Status Bit 10: CUEFault	bool	Fault state of auxiliary equipment CUE. 0 = No fault 1 = Fault.
	Pump2Status Bit 11: PumpDisabled	bool	Enabled/disabled state of pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00452	Pump2ControlSource	enum	Control source of pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00453	Pump2ConnectionType	enum	Pump connection type. 0 = The pump is controlled from the CU 36X output relay. 1 = The pump is controlled from the IO 351B output relay. 2 = The pump is controlled from the CU 36X and VFD. 3 = The pump is controlled from the IO 351B and VFD.
00454	Pump2OperatingTimeHI	1 min.	Total operating time.
00455	Pump2OperatingTimeLO		
00456	Pump2TimeToServiceHI	1 min.	Time to next service.
00457	Pump2TimeToServiceLO		
00458	Pump2OperatingTimeYesterday	1 min.	Operating time yesterday.
00459	Pump2OperatingTimeToday	1 min.	Operating time today.
00460	Pump2LatestOperatingTime	1 s	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.
00464	Pump2StartCounterToday	unscaled	Total number of pump starts today.
00465	Pump2StartsPerHour	unscaled	Number of pump starts within the last hour.
00466	Pump2Flow	0.1 litre/s	Calculated average or measured pump flow.
00467	Pump2LatestFlow	0.1 litre/s	Latest calculated/measured flow (capacity).
00468	Pump2Current	0.1 A	Motor current.
00469	Pump2LatestCurrent	0.1 A	Latest motor current.

Address	Register name	Scale	Description
00470	Pump2Voltage	0.1 V	Voltage.
00471	Pump2Insulation	10 kΩ	Motor insulation resistance.
00472	Pump2WaterInOil	0.1 %	Motor water-in-oil measurement.
00473	Pump2Alarms1	bits	See section *Fig. 25 Interlocking from another controller*.
00474	Pump2Alarms2	bits	See section *Fig. 25 Interlocking from another controller*.
00475	Pump2Alarms3	bits	See section *Fig. 25 Interlocking from another controller*.
00476	Pump2Warnings1	bits	See section *Fig. 25 Interlocking from another controller*.
00477	Pump2Warnings2	bits	See section *Fig. 25 Interlocking from another controller*.
00478	Pump2Warnings3	bits	See section *Fig. 25 Interlocking from another controller*.
00479	Pump2MotorTemperature1	1 °C	Motor temperature 1.
00480	Pump2MotorTemperature2	1 °C	Motor temperature 2.
00481	Pump2PowerHI	1 W	Power consumption.
00482	Pump2PowerLO		
00483	Pump2EnergyHI	0.1 kWh	Energy consumption.
00484	Pump2EnergyLO		
00485	Pump2CosPhi	0.01	Motor cos φ.
00486	Pump2Frequency	0.1 Hz	Motor-applied frequency.
00487	Pump2VFDmode	enum	Mode of variable-frequency drive. 0 = VFD not controlled 1 = - 2 = Stopped 3 = Reverse start 4 = Start flushing 5 = Normal 6 = Run flushing 7 = Stop flushing 8 = Specific-energy test.
00488	Pump2Torque	0.1 Nm	Motor torque.
00489	Pump2Asym	0.1 %	Line current asymmetry.
00490	Pump2Sensors.WIO Bit 0: WaterInOilSensor	bool	Presence of water-in-oil (WIO) sensor. 0 = Not present 1 = Present.
	Pump2Sensors.Current Bit 1: MotorCurrentSensor	bool	Presence of current sensor. 0 = Not present 1 = Present.
00491	Pump2Alarms4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump2Alarms4 Bit: 13	bool	Pump blocked alarm 0 = No alarm 1 = Alarm
	Pump2Alarms4 Bit 14:	bool	Power sensor signal fault alarm 0 = No alarm 1 = Alarm
00492	Pump2Warnings4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump2Warnings4 Bit 13:	bool	Pump blocked warning 0 = No warning 1 = Warning
	Pump2Warnings4 Bit 14:	bool	Power sensor signal fault warning 0 = No warning 1 = Warning
00493	Pump2AntiBlockingCounter	bits	Number of anti blockings in the pump

9.9 Pump 3 register block

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

Address	Register name	Scale	Description
00501	Pump3Status Bit 0: Presence	bool	Presence of pump. 0 = Not present 1 = Present.
	Pump3Status Bit 1: Running	bool	Running state of pump. 0 = Not running 1 = Running.
	Pump3Status Bit 2: MonitoringFault	bool	Fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump3Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump3Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump3Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump3Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump3Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump3Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump3Status Bit 9: CUEPresent	bool	Presence of auxiliary equipment CUE. 0 = Not present 1 = Present.
	Pump3Status Bit 10: CUEFault	bool	Fault state of auxiliary equipment CUE. 0 = No fault 1 = Fault.
	Pump3Status Bit 11: PumpDisabled	bool	Enabled/disabled state of pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00502	Pump3ControlSource	enum	Control source of pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00503	Pump3ConnectionType	enum	Pump connection type. 0 = The pump is controlled from the CU 36X output relay. 1 = The pump is controlled from the IO 351B output relay. 2 = The pump is controlled from the CU 36X and VFD. 3 = The pump is controlled from the IO 351B and VFD.
00504	Pump3OperatingTimeHI	1 min.	Total operating time.
00505	Pump3OperatingTimeLO		
00506	Pump3TimeToServiceHI	1 min.	Time to next service.
00507	Pump3TimeToServiceLO		
00508	Pump3OperatingTimeYesterday	1 min.	Operating time yesterday.
00509	Pump3OperatingTimeToday	1 min.	Operating time today.
00510	Pump3LatestOperatingTime	1 s	Operating time last time it was operated.
00511	Pump3StartCounterHI	unscaled	Total number of pump starts.
00512	Pump3StartCounterLO		
00513	Pump3StartCounterYesterday	unscaled	Total number of pump starts yesterday.
00514	Pump3StartCounterToday	unscaled	Total number of pump starts today.
00515	Pump3StartsPerHour	unscaled	Number of pump starts within the last hour.
00516	Pump3Flow	0.1 litre/s	Calculated average or measured pump flow.
00517	Pump3LatestFlow	0.1 litre/s	Latest calculated/measured flow (capacity).
00518	Pump3Current	0.1 A	Motor current.
00519	Pump3LatestCurrent	0.1 A	Latest motor current.

Address	Register name	Scale	Description
00520	Pump3Voltage	0.1 V	Voltage.
00521	Pump3Insulation	10 kΩ	Motor insulation resistance.
00522	Pump3WaterInOil	0.1 %	Motor water-in-oil measurement.
00523	Pump3Alarms1	bits	See fig. 25.
00524	Pump3Alarms2	bits	See fig. 25.
00525	Pump3Alarms3	bits	See fig. 25.
00526	Pump3Warnings1	bits	See fig. 25.
00527	Pump3Warnings2	bits	See fig. 25.
00528	Pump3Warnings3	bits	See fig. 25.
00529	Pump3MotorTemperature1	1 °C	Motor temperature 1.
00530	Pump3MotorTemperature2	1 °C	Motor temperature 2.
00531	Pump3PowerHI	1 W	Power consumption.
00532	Pump3PowerLO		
00533	Pump3EnergyHI	0.1 kWh	Energy consumption.
00534	Pump3EnergyLO		
00535	Pump3CosPhi	0.01	Motor cos φ.
00536	Pump3Frequency	0.1 Hz	Motor-applied frequency.
00537	Pump3VFDmode	enum	Mode of variable-frequency drive. 0 = VFD not controlled 1 = - 2 = Stopped 3 = Reverse start 4 = Start flushing 5 = Normal 6 = Run flushing 7 = Stop flushing 8 = Specific-energy test.
00538	Pump3Torque	0.1 Nm	Motor torque.
00539	Pump3Asym	0.1 %	Line current asymmetry.
00540	Pump3Sensors.WIO Bit 0: WaterInOilSensor	bool	Presence of water-in-oil (WIO) sensor. 0 = Not present 1 = Present.
	Pump3Sensors.Current Bit 1: MotorCurrentSensor	bool	Presence of current sensor. 0 = Not present 1 = Present.
00541	Pump3Alarms4	bits	See fig. 25.
	Pump3Alarms4 Bit: 13	bool	Pump blocked alarm 0 = No alarm 1 = Alarm
	Pump3Alarms4 Bit 14:	bool	Power sensor signal fault alarm 0 = No alarm 1 = Alarm
00542	Pump3Warnings4	bits	See fig. 25.
	Pump3Warnings4 Bit 13:	bool	Pump blocked warning 0 = No warning 1 = Warning
	Pump3Warnings4 Bit 14:	bool	Power sensor signal fault warning 0 = No warning 1 = Warning
00543	Pump3AntiBlockingCounter	bits	Number of anti blockings in the pump

9.10 Pump 4 register block

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

Address	Register name	Scale	Description
00551	Pump4Status Bit 0: Presence	bool	Presence of pump. 0 = Not present 1 = Present.
	Pump4Status Bit 1: Running	bool	Running state of pump. 0 = Not running 1 = Running.
	Pump4Status Bit 2: MonitoringFault	bool	Fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump4Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump4Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump4Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump4Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump4Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump4Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump4Status Bit 9: CUEPresent	bool	Presence of auxiliary equipment CUE. 0 = Not present 1 = Present.
	Pump4Status Bit 10: CUEFault	bool	Fault state of auxiliary equipment CUE. 0 = No fault 1 = Fault.
	Pump4Status Bit 11: PumpDisabled	bool	Enabled/disabled state of pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00552	Pump4ControlSource	enum	Control source of pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00553	Pump4ConnectionType	enum	Pump connection type. 0 = The pump is controlled from the CU 36X output relay. 1 = The pump is controlled from the IO 351B output relay. 2 = The pump is controlled from the CU 36X and VFD. 3 = The pump is controlled from the IO 351B and VFD.
00554	Pump4OperatingTimeHI	1 min.	Total operating time.
00555	Pump4OperatingTimeLO		
00556	Pump4TimeToServiceHI	1 min.	Time to next service.
00557	Pump4TimeToServiceLO		
00558	Pump4OperatingTimeYesterday	1 min.	Operating time yesterday.
00559	Pump4OperatingTimeToday	1 min.	Operating time today.
00560	Pump4LatestOperatingTime	1 s	Operating time last time it was operated.
00561	Pump4StartCounterHI	unscaled	Total number of pump starts.
00562	Pump4StartCounterLO		
00563	Pump4StartCounterYesterday	unscaled	Total number of pump starts yesterday.
00564	Pump4StartCounterToday	unscaled	Total number of pump starts today.
00565	Pump4StartsPerHour	unscaled	Number of pump starts within the last hour.
00566	Pump4Flow	0.1 litre/s	Calculated average or measured pump flow.
00567	Pump4LatestFlow	0.1 litre/s	Latest calculated/measured flow (capacity).
00568	Pump4Current	0.1 A	Motor current.
00569	Pump4LatestCurrent	0.1 A	Latest motor current.

Address	Register name	Scale	Description
00570	Pump4Voltage	0.1 V	Voltage.
00571	Pump4Insulation	10 kΩ	Motor insulation resistance.
00572	Pump4WaterInOil	0.1 %	Motor water-in-oil measurement.
00573	Pump4Alarms1	bits	See section *Fig. 25 Interlocking from another controller*.
00574	Pump4Alarms2	bits	See section *Fig. 25 Interlocking from another controller*.
00575	Pump4Alarms3	bits	See section *Fig. 25 Interlocking from another controller*.
00576	Pump4Warnings1	bits	See section *Fig. 25 Interlocking from another controller*.
00577	Pump4Warnings2	bits	See section *Fig. 25 Interlocking from another controller*.
00578	Pump4Warnings3	bits	See section *Fig. 25 Interlocking from another controller*.
00579	Pump4MotorTemperature1	1 °C	Motor temperature 1.
00580	Pump4MotorTemperature2	1 °C	Motor temperature 2.
00581	Pump4PowerHI	1 W	Power consumption.
00582	Pump4PowerLO		
00583	Pump4EnergyHI	0.1 kWh	Energy consumption.
00584	Pump4EnergyLO		
00585	Pump4CosPhi	0.01	Motor cos φ.
00586	Pump4Frequency	0.1 Hz	Motor-applied frequency.
00587	Pump4VFDmode	enum	Mode of variable-frequency drive. 0 = VFD not controlled 1 = - 2 = Stopped 3 = Reverse start 4 = Start flushing 5 = Normal 6 = Run flushing 7 = Stop flushing 8 = Specific-energy test.
00588	Pump4Torque	0.1 Nm	Motor torque.
00589	Pump4Asym	0.1 %	Line current asymmetry.
00590	Pump4Sensors.WIO Bit 0: WaterInOilSensor	bool	Presence of water-in-oil (WIO) sensor. 0 = Not present 1 = Present.
	Pump4Sensors.Current Bit 1: MotorCurrentSensor	bool	Presence of current sensor. 0 = Not present 1 = Present.
00591	Pump4Alarms4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump4Alarms4 Bit: 13	bool	Pump blocked alarm 0 = No alarm 1 = Alarm
	Pump3Alarms4 Bit 14:	bool	Power sensor signal fault alarm 0 = No alarm 1 = Alarm
00592	Pump4Warnings4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump4Warnings4 Bit 13:	bool	Pump blocked warning 0 = No warning 1 = Warning
	Pump4Warnings4 Bit 14:	bool	Power sensor signal fault warning 0 = No warning 1 = Warning
00593	Pump4AntiBlockingCounter	bits	Number of anti blockings in the pump

9.11 Pump 5 register block

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

Address	Register name	Scale	Description
00601	Pump5Status Bit 0: Presence	bool	Presence of pump. 0 = Not present 1 = Present.
	Pump5Status Bit 1: Running	bool	Running state of pump. 0 = Not running 1 = Running.
	Pump5Status Bit 2: MonitoringFault	bool	Fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump5Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump5Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump5Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump5Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump5Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump5Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump5Status Bit 9: CUEPresent	bool	Presence of auxiliary equipment CUE. 0 = Not present 1 = Present.
	Pump5Status Bit 10: CUEFault	bool	Fault state of auxiliary equipment CUE. 0 = No fault 1 = Fault.
	Pump5Status Bit 11: PumpDisabled	bool	Enabled/disabled state of pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00602	Pump5ControlSource	enum	Control source of pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00603	Pump5ConnectionType	enum	Pump connection type. 0 = The pump is controlled from the CU 36X output relay. 1 = The pump is controlled from the IO 351B output relay. 2 = The pump is controlled from the CU 36X and VFD. 3 = The pump is controlled from the IO 351B and VFD.
00604	Pump5OperatingTimeHI	1 min.	Total operating time.
00605	Pump5OperatingTimeLO		
00606	Pump5TimeToServiceHI	1 min.	Time to next service.
00607	Pump5TimeToServiceLO		
00608	Pump5OperatingTimeYesterday	1 min.	Operating time yesterday.
00609	Pump5OperatingTimeToday	1 min.	Operating time today.
00610	Pump5LatestOperatingTime	1 s	Operating time last time it was operated.
00611	Pump5StartCounterHI	unscaled	Total number of pump starts.
00612	Pump5StartCounterLO		
00613	Pump5StartCounterYesterday	unscaled	Total number of pump starts yesterday.
00614	Pump5StartCounterToday	unscaled	Total number of pump starts today.
00615	Pump5StartsPerHour	unscaled	Number of pump starts within the last hour.
00616	Pump5Flow	0.1 litre/s	Calculated average or measured pump flow.
00617	Pump5LatestFlow	0.1 litre/s	Latest calculated/measured flow (capacity).
00618	Pump5Current	0.1 A	Motor current.
00619	Pump5LatestCurrent	0.1 A	Latest motor current.

Address	Register name	Scale	Description
00620	Pump5Voltage	0.1 V	Voltage.
00621	Pump5Insulation	10 kΩ	Motor insulation resistance.
00622	Pump5WaterInOil	0.1 %	Motor water-in-oil measurement.
00623	Pump5Alarms1	bits	See section *Fig. 25 Interlocking from another controller*.
00624	Pump5Alarms2	bits	See section *Fig. 25 Interlocking from another controller*.
00625	Pump5Alarms3	bits	See section *Fig. 25 Interlocking from another controller*.
00626	Pump5Warnings1	bits	See section *Fig. 25 Interlocking from another controller*.
00627	Pump5Warnings2	bits	See section *Fig. 25 Interlocking from another controller*.
00628	Pump5Warnings3	bits	See section *Fig. 25 Interlocking from another controller*.
00629	Pump5MotorTemperature1	1 °C	Motor temperature 1.
00630	Pump5MotorTemperature2	1 °C	Motor temperature 2.
00631	Pump5PowerHI	1 W	Power consumption.
00632	Pump5PowerLO		
00633	Pump5EnergyHI	0.1 kWh	Energy consumption.
00634	Pump5EnergyLO		
00635	Pump5CosPhi	0.01	Motor cos φ.
00636	Pump5Frequency	0.1 Hz	Motor-applied frequency.
00637	Pump5VFDmode	enum	Mode of variable-frequency drive. 0 = VFD not controlled 1 = - 2 = Stopped 3 = Reverse start 4 = Start flushing 5 = Normal 6 = Run flushing 7 = Stop flushing 8 = Specific-energy test.
00638	Pump5Torque	0.1 Nm	Motor torque.
00639	Pump5Asym	0.1 %	Line current asymmetry.
00640	Pump5Sensors.WIO Bit 0: WaterInOilSensor	bool	Presence of water-in-oil (WIO) sensor. 0 = Not present 1 = Present.
	Pump5Sensors.Current Bit 1: MotorCurrentSensor	bool	Presence of current sensor. 0 = Not present 1 = Present.
00641	Pump5Alarms4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump5Alarms4 Bit: 13	bool	Pump blocked alarm 0 = No alarm 1 = Alarm
	Pump5Alarms4 Bit 14:	bool	Power sensor signal fault alarm 0 = No alarm 1 = Alarm
00642	Pump5Warnings4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump5Warnings4 Bit 13:	bool	Pump blocked warning 0 = No warning 1 = Warning
	Pump5Warnings4 Bit 14:	bool	Power sensor signal fault warning 0 = No warning 1 = Warning
00643	Pump5AntiBlockingCounter	bits	Number of anti blockings in the pump

9.12 Pump 6 register block

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

Address	Register name	Scale	Description
00651	Pump6Status Bit 0: Presence	bool	Presence of pump. 0 = Not present 1 = Present.
	Pump6Status Bit 1: Running	bool	Running state of pump. 0 = Not running 1 = Running.
	Pump6Status Bit 2: MonitoringFault	bool	Fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump6Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump6Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump6Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump6Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump6Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump6Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump6Status Bit 9: CUEPresent	bool	Presence of auxiliary equipment CUE. 0 = Not present 1 = Present.
	Pump6Status Bit 10: CUEFault	bool	Fault state of auxiliary equipment CUE. 0 = No fault 1 = Fault.
	Pump6Status Bit 11: PumpDisabled	bool	Enabled/disabled state of pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00652	Pump6ControlSource	enum	Control source of pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00653	Pump6ConnectionType	enum	Pump connection type. 0 = The pump is controlled from the CU 36X output relay. 1 = The pump is controlled from the IO 351B output relay. 2 = The pump is controlled from the CU 36X and VFD. 3 = The pump is controlled from the IO 351B and VFD.
00654	Pump6OperatingTimeHI	1 min.	Total operating time.
00655	Pump6OperatingTimeLO		
00656	Pump6TimeToServiceHI	1 min.	Time to next service.
00657	Pump6TimeToServiceLO		
00658	Pump6OperatingTimeYesterday	1 min.	Operating time yesterday.
00659	Pump6OperatingTimeToday	1 min.	Operating time today.
00660	Pump6LatestOperatingTime	1 s	Operating time last time it was operated.
00661	Pump6StartCounterHI	unscaled	Total number of pump starts.
00662	Pump6StartCounterLO		
00663	Pump6StartCounterYesterday	unscaled	Total number of pump starts yesterday.
00664	Pump6StartCounterToday	unscaled	Total number of pump starts today.
00665	Pump6StartsPerHour	unscaled	Number of pump starts within the last hour.
00666	Pump6Flow	0.1 litre/s	Calculated average or measured pump flow.
00667	Pump6LatestFlow	0.1 litre/s	Latest calculated/measured flow (capacity).
00668	Pump6Current	0.1 A	Motor current.
00669	Pump6LatestCurrent	0.1 A	Latest motor current.

Address	Register name	Scale	Description
00670	Pump6Voltage	0.1 V	Voltage.
00671	Pump6Insulation	10 kΩ	Motor insulation resistance.
00672	Pump6WaterInOil	0.1 %	Motor water-in-oil measurement.
00673	Pump6Alarms1	bits	See section *Fig. 25 Interlocking from another controller*.
00674	Pump6Alarms2	bits	See section *Fig. 25 Interlocking from another controller*.
00675	Pump6Alarms3	bits	See section *Fig. 25 Interlocking from another controller*.
00676	Pump6Warnings1	bits	See section *Fig. 25 Interlocking from another controller*.
00677	Pump6Warnings2	bits	See section *Fig. 25 Interlocking from another controller*.
00678	Pump6Warnings3	bits	See section *Fig. 25 Interlocking from another controller*.
00679	Pump6MotorTemperature1	1 °C	Motor temperature 1.
00680	Pump6MotorTemperature2	1 °C	Motor temperature 2.
00681	Pump6PowerHI	1 W	Power consumption.
00682	Pump6PowerLO		
00683	Pump6EnergyHI	0.1 kWh	Energy consumption.
00684	Pump6EnergyLO		
00685	Pump6CosPhi	0.01	Motor cos φ.
00686	Pump6Frequency	0.1 Hz	Motor-applied frequency.
00687	Pump6VFDmode	enum	Mode of variable-frequency drive. 0 = VFD not controlled 1 = - 2 = Stopped 3 = Reverse start 4 = Start flushing 5 = Normal 6 = Run flushing 7 = Stop flushing 8 = Specific-energy test.
00688	Pump6Torque	0.1 Nm	Motor torque.
00689	Pump6Asym	0.1 %	Line current asymmetry.
00690	Pump6Sensors.WIO Bit 0: WaterInOilSensor	bool	Presence of water-in-oil (WIO) sensor. 0 = Not present 1 = Present.
	Pump6Sensors.Current Bit 1: MotorCurrentSensor	bool	Presence of current sensor. 0 = Not present 1 = Present.
00691	Pump6Alarms4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump6Alarms4 Bit: 13	bool	Pump blocked alarm 0 = No alarm 1 = Alarm
	Pump6Alarms4 Bit 14:	bool	Power sensor signal fault alarm 0 = No alarm 1 = Alarm
00692	Pump6Warnings4	bits	See section *Fig. 25 Interlocking from another controller*.
	Pump6Warnings4 Bit 13:	bool	Pump blocked warning 0 = No warning 1 = Warning
	Pump6Warnings4 Bit 14:	bool	Power sensor signal fault warning 0 = No warning 1 = Warning
00693	Pump6AntiBlockingCounter	bits	Number of anti blockings in the pump

9.13 Alarm simulation register block

Address	Register name	Scale	Description
00701	SimulationEventCode	enum	Event code to simulate.
00702	SimulationEventSource	enum	Event source to simulate.
00703	SimulationEventDeviceNo	enum	Event device number to simulate.
00704	SimulationEventActionType	enum	0 = Warning 1 = Alarm 2 = Disabled.
00705	SimulationActivate	bool	Activation of simulation features. 0 = Deactivate simulation 1 = Activate simulation.
00706	SimulationStatus Bit 0: SimulationActive	bool	State of simulation. 0 = Not active 1 = Active.

9.14 User register block

Address	Register name	Scale	Description
00751-00800	UserRegisters	unscaled	This area is for device labelling by the user. Neither the CU 36X nor the CIM will modify this area. The user area values are stored in the device and will remain after a power-off.

9.15 Name string register block

Address	Register name	Scale	Description
00801-00920	NameRegisterArea	UTF-8 chars.	Name string read from the Dedicated Controls CU 36X. UTF-8 is a variable-length character encoding for Unicode. It can represent any character in the Unicode standard. It may take up to 60 seconds for a change to be visible.

9.16 Hour log register block

Generally the Modbus master application can select the relevant log series and the relevant number of hours back in time. Typically several communication sessions (request telegrams) are needed to read the data.

The communication interface ensures that logged data is protected against internal update during the time it is accessed from Modbus, so that the Hour log constitutes a time-consistent block (data coherency). Every time the real-time clock increments by one hour, all the logged data in the Hour log is shifted one hour back in time (and the oldest data set is cleared). The exact time where this happens will be delayed a few seconds relative to the hour incrementation, so to be sure to read Hour log data that has been correctly updated, it is recommended to read data at least 30 seconds after the hour incrementation.

Address	Register name	Scale	Description
02001-02072	PitOverflowTimeHourLog1…72	1 min.	Pit, incremental overflow time, hour log 1…72.
02073-02144	PitOverflowCntHourLog1…72	unscaled	Pit, incremental number of overflows, hour log 1…72.
02145-02216	PitOverflowVolumeHourLog1…72	0.1 m^3	Pit, incremental overflow volume, hour log 1…72.
02217-02288	PitSpecificEnergyHourLog1…72	1 Wh/m^3	Pit, specific energy, hour log 1…72.
02289-02360	PitVolumeHourLog1…72	0.1 m^3	Pit, incremental pumped volume, hour log 1…72.
02361-02432	PitEnergyHourLog1…72	0.1 kWh	Pit, incremental energy consumption, hour log 1…72.
02433-02504	Pit2PumpsOprTimeHourLog1…72	1 min.	Pit, incremental operating time (two pumps operating simultaneously), hour log 1…72.
02505-02576	Pit3PumpsOprTimeHourLog1…72	1 min.	Pit, incremental operating time (three pumps operating simultaneously), hour log 1…72.
02577-02648	Pit4PumpsOprTimeHourLog1…72	1 min.	Pit, incremental operating time (four pumps operating simultaneously), hour log 1…72.
02649-02720	Pit5PumpsOprTimeHourLog1…72	1 min.	Pit, incremental operating time (five pumps operating simultaneously), hour log 1…72.
02721-02792	Pit6PumpsOprTimeHourLog1…72	1 min.	Pit, incremental operating time (six pumps operating simultaneously), hour log 1…72.
02793-02864	Pump1OprTimeHourLog1…72	1 min.	Pump 1, incremental operating time, hour log 1…72.
02865-02936	Pump1StartCntHourLog1…72	unscaled	Pump 1, incremental number of starts, hour log 1…72.
02937-03008	Pump1AvgFlowHourLog1…72	0.1 litre/s	Pump 1, average flow, hour log 1…72.
03009-03080	Pump1AvgCurrentHourLog1…72	0.1 A	Pump 1, average current, hour log 1…72.
03081-03152	Pump2OprTimeHourLog1…72	1 min.	Pump 2, incremental operating time, hour log 1…72.
03153-03224	Pump2StartCntHourLog1…72	unscaled	Pump 2, incremental number of starts, hour log 1…72.
03225-03296	Pump2AvgFlowHourLog1…72	0.1 litre/s	Pump 2, average flow, hour log 1…72.
03297-03368	Pump2AvgCurrentHourLog1…72	0.1 A	Pump 2, average current, hour log 1…72.
03369-03440	Pump3OprTimeHourLog1…72	1 min.	Pump 3, incremental operating time, hour log 1…72.
03441-03512	Pump3StartCntHourLog1…72	unscaled	Pump 3, incremental number of starts, hour log 1…72.
03513-03584	Pump3AvgFlowHourLog1…72	0.1 litre/s	Pump 3, average flow, hour log 1…72.
03585-03656	Pump3AvgCurrentHourLog…72	0.1 A	Pump 3, average current, hour log 1…72.
03657-03728	Pump4OprTimeHourLog1…72	1 min.	Pump 4, incremental operating time, hour log 1…72.
03729-03800	Pump4StartCntHourLog1…72	unscaled	Pump 4, incremental number of starts, hour log 1…72.
03801-03872	Pump4AvgFlowHourLog1…72	0.1 litre/s	Pump 4, average flow, hour log 1…72.
03873-03944	Pump4AvgCurrentHourLog…72	0.1 A	Pump 4, average current, hour log 1…72.
03945-04016	Pump5OprTimeHourLog1…72	1 min.	Pump 5, incremental operating time, hour log 1…72.
04017-04088	Pump5StartCntHourLog1…72	unscaled	Pump 5, incremental number of starts, hour log 1…72.
04089-04160	Pump5AvgFlowHourLog1…72	0.1 litre/s	Pump 5, average flow, hour log 1…72.
04161-04232	Pump5AvgCurrentHourLog…72	0.1 A	Pump 5, average current, hour log 1…72.
04233-04304	Pump6OprTimeHourLog1…72	1 min.	Pump 6, incremental operating time, hour log 1…72.
04305-04376	Pump6StartCntHourLog1…72	unscaled	Pump 6, incremental number of starts, hour log 1…72.
04377-04448	Pump6AvgFlowHourLog1…72	0.1 litre/s	Pump 6, average flow, hour log 1…72.
04449-04521	Pump6AvgCurrentHourLog…72	0.1 A	Pump 6, average current, hour log 1…72.

9.17 Event log register block

The event log contains the latest 50 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 1 = CU 36X 2 = IO 351B 3 = IO 111, pump 4 = MP 204, pump 5 = Analog input 6 = Pump 7 = Add-on CIM module 8 = Battery/UPS 9 = Mixer 10 = Analog input, level sensor 11 = Analog input, flow sensor 12 = Analog input, power sensor 13 = Analog input, user-defined sensor 14 = CUE (variable-frequency drive).
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 3 = Value of related number, pump 3 4 = Value of related number, pump 4 5 = Value of related number, pump 5 6 = Value of related number, pump 6.
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 s	Seconds since midnight January 1st 1970 (UNIX time).
06008	EventTimeStampLog1LO		
06009-06344	Event log 2…49	-	-
06345	EventIDLog50	unscaled	Event ID for logged event No 50.
06346	EventCodeLog50	enum	Event code for logged event No 50.
06347	EventSourceLog50	enum	Event source for logged event No 50.
06348	EventDeviceNo	unscaled	Device number related to the event or its recognition.
06349	EventTypeAndConditionLog50	enum	Event type and condition of logged event No 50.
06350	EventTimeStampLog50HI	1 s	Seconds since midnight January 1st 1970 (UNIX time).
06351	EventTimeStampLog50LO		

9.18 Data log index register block

This is an index area for the configurable data log. The log data index registers are read-only.

See section *11.3 Reading the configurable data log series* for detailed information on how to read the configurable log series.

By default the configurable logs are not set up. This can only be done with a PC Tool or via the CU 36X control panel. For further information, see installation and operating instructions for Dedicated Controls.

Address	Register name	Scale	Description
07001	NoOfLogSeries	unscaled	Number of available log series [0; 64].
07002	LogSeries1ItemNo	unscaled	Log series 1 item number. See section *11.3 Reading the configurable data log series*.
07003	LogSeries1RegAddr	unscaled	Register start address of log series 1.
07004	LogSeries1SamplingTime	1 s	Time period between samples in log series 1.
07005	LogSeries1NoOfSamples	unscaled	Number of samples in log series 1, N_1.
07006	LogSeries2ItemNo	unscaled	Log series 2 item number. See section *11.3 Reading the configurable data log series*.
07007	LogSeries2RegAddr	unscaled	Register start address of log series 2.
07008	LogSeries2SamplingTime	1 s	Time period between samples in log series 2.
07009	LogSeries2NoOfSamples	unscaled	Number of samples in log series 2, N_2.
…	LogSeries#ItemNo	unscaled	Log series # item number. See section *11.3 Reading the configurable data log series*.
…	LogSeries#RegAddr	unscaled	Register start address of log series #.
…	LogSeries#SamplingTime	1 s	Time period between samples in log series #.
…	LogSeries#NoOfSamples	unscaled	Number of samples in log series #, $N_{\#}$.
07254	LogSeriesLItemNo	unscaled	Log series "L" item number (last series). See section *11.3 Reading the configurable data log series*.
07255	LogSeriesLRegAddr	unscaled	Register start address of log series "L".
07256	LogSeriesLSamplingTime	1 s	Time period between samples in log series "L".
07257	LogSeriesLNoOfSamples	unscaled	Number of samples in log series "L", N_L.
07258	LogSeriesEndMark	unscaled	End mark to end the index. Is always 0.

… indicates variable register address.

9.19 Data log series register block

Data area for the configurable data log series (max. 64 series). The log data are read-only and have a fixed starting address, so log series 1 always starts at register 07301.

See section *11.3 Reading the configurable data log series* for detailed information on how to read the configurable log series.

Address	Register name	Scale	Description
07301	LogSeries1ItemNo	unscaled	Log series 1 item number. See section *11.3 Reading the configurable data log series*.
07302	LogSeries1SamplingTime	1 s	Time period between samples in log series 1, configurable on the CU 36X control panel.
07303	LogSeries1NoOfSamples	unscaled	Number of samples in log series 1, N_1, configurable on the CU 36X control panel.
07304	LogSeries1TimeStampHI	1 s	Log series 1 Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No 2 in this series, etc.
07305	LogSeries1TimeStampLO		
07306	LogSeries1Sample1	-	Value of log series 1 sample No 1.
…	LogSeries1SampleN1	-	Value of log series 1 sample No N_1 (last sample in series).
…	LogSeries2ItemNo	-	Log series 2 item number. See section *11.3 Reading the configurable data log series*.
…	LogSeries2SamplingTime	-	Time period between samples in log series 2, configurable on the CU 36X control panel.
…	LogSeries2TimeStampHI	-	Log series 2 Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No 2 in this series, etc.
…	LogSeries2TimeStampLO		
…	LogSeries2Sample1	-	Value of log series 2 sample No 1.
…	…	-	-
…	LogSeries2SampleN2	-	Value of log series 2 sample No N_2 (last sample in series).
…	LogSeries#ItemNo	-	Log series # item number. See section *11.3 Reading the configurable data log series*.
…	LogSeries#SamplingTime	-	Time period between samples in log series #.
…	LogSeries#NoOfSamples	-	Number of samples in log series #, $N_{\#}$.
…	LogSeries#TimeStampHI	-	Log series # Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No 2 in this series, etc.
…	LogSeries#TimeStampLO		
…	LogSeries#Sample1	-	Value of log series # sample No 1.
…	…	-	-
…	LogSeries#SampleN#	-	Value of log series # sample No $N_{\#}$ (last sample in series).
…	LogSeriesLItemNo	-	Log series "L" item number. See section *11.3 Reading the configurable data log series*.
…	LogSeriesLSamplingTime	-	Time period between samples in log series "L".
…	LogSeriesLNoOfSamples	-	Number of samples in log series "L", N_L.
…	LogSeriesLTimeStampHI	-	Log series "L" Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No 2 in this series, etc.
…	LogSeriesLTimeStampLO		
…	LogSeriesLSample1	-	Value of log series "L" sample No 1.
…	…	-	-
…	LogSeriesLSampleN1	-	Value of log series "L" sample No N_L (last sample in series).

… indicates variable register address.

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

Note

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

10.1 Hardware setup (CIM 200)

Step	Action
1	Install the CIM 200 in the Grundfos pump according to the pump documentation.
2	Complete the pump configuration, e.g. sensor configuration and local mode. This can be done either on the pump control panel, via the R100 or Grundfos GO Remote or Grundfos PC Tool E-Products.
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 the CIM 200 to the Modbus network.
8	Confirm that the GENIbus LED is constantly green and that the Modbus LED is either off (if no master is actively polling the slave) or flashing green (indicating error-free communication).
The 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 the CIM 250 in the Grundfos pump according to the pump documentation.
2	Fit a GSM antenna to the CIM module SMA connector. See section *6.1.1 Fitting a GSM antenna*.
3	Insert the SIM card in the CIM 250. See section *6.1.2 Inserting the SIM card*.
4	Power on the Grundfos product
5	Observe that LED2 turns steady green (see section *6.2 Status LEDs*), indicating that the CIM module is fitted correctly.
6	Observe that LED1 blinks yellow and changes to yellow pulsing after approximately 30 s (see section *6.2 Status LEDs*), indicating that the GSM connection is working. By making a call-up from a phone the connection can be verified (LED1 turns steady yellow).
7	For configuring the 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.
The 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 the CIM 250 in the Grundfos product according to the product documentation.
2	Fit a GSM antenna to the CIM module SMA connector. See section *6.1.1 Fitting a GSM antenna*.
3	Insert the SIM card in the CIM 250. See section *6.1.2 Inserting the SIM card*.
4	Power on the Grundfos product
5	Observe that LED2 turns steady green. See section *6.2 Status LEDs*.
6	Observe that LED1 blinks yellow and changes to yellow pulsing after approximately 30 s (see section *6.2 Status LEDs*), indicating that the GSM connection is working.
7	For configuring the 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 should be "Context active" if ready and "Connected" if a Modbus TCP master is already communicating.
The 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 the CIM 500 in the Grundfos Grundfos product according to the pump 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 steady green and LED1 remaining off.
4	Complete the pump configuration, e.g. sensor configuration and selection of local Operating mode, local Control mode and local Setpoint (e.g. via 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 the CIM 500 (e.g. 192.168.1.1) and the subnet mask to 255.255.255.0 (See "A.1 How to configure an IP address on your PC" on page 81).
7	Open your internet browser and make contact to the CIM 500 Web server. Factory default address: 192.168.1.100
8	Log on to the Web server. Default: User: 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 (e.g. 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.

- The CIM 500 LED 1 will be flashing 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 Web server simultaneously with a connection to a Modbus TCP master.
- It is possible to have connection to more Modbus TCP masters simultaneously, e.g. to have connection to PC Tool CIM while connected to another Modbus TCP master.

11. Detailed descriptions of functionality

11.1 SCADA PIN code protection

It is always possible to get read access via Modbus, but if the CU 36X control unit is SCADA PIN-code-protected (PitStatus.ScadaPinCodeEnabled, register 00202, bit 4 = 1), write access requires that the user has entered the correct PIN-code in (ScadaPinCode, register 00109).

Writing the correct PIN code value will trigger the write access control, and write access will be open, which can be verified with the status bit PitStatus.WriteAccess (register 00202, bit 5 = 1).

To remove write access, the SCADA PIN code input register (ScadaPinCode, register 00109) can be set with a value of 0.

The SCADA PIN code protection cannot be enabled or disabled via Modbus.

11.2 Reading the event log

The event log has a size of 350 registers containing the latest 50 alarm and warning events. The number of contained event logs can be read from NoOfEventsInLog (register 06001).

Each event is represented as an event record of seven registers:

- EventID
- EventCode
- EventSource
- EventDeviceNo
- EventTypeAndCondition
- EventTimeStampHI
- EventTimeStampLO.

The EventID is a unique "tag" for the event record. These IDs are incremented successively corresponding to the succession of the events they represent. The event log can be handled in three ways:

- Reading the complete log (all 50 event records) regularly and afterwards sorting "new" ones from "old" ones.
- Reading the event ID of the latest record EventLogLatestID (register 00216) and comparing with the event ID of the latest record that has been read previously to see how many "new" records have been generated. Then afterwards reading only the "new" ones.
- Clearing the event log with PitControl.ResetEventLog (register 00101, bit 2) after it has been read. Then the event log will always contain "new" events only.

Note

The CIM module ensures that logged data is protected against internal update during the time it is accessed from Modbus, so that the event log constitutes a time-consistent block (data coherency).

11.3 Reading the configurable data log series

LogSeriesItemNo

The log series item numbers are shown in the table below.
Note that the scaling of the registers with the present values is identical to the scaling of the logged data values except for power values where the scaling has been changed from [1 W] to [10 W] to fit into 16 bit.

Log series item No	Log item register	Scale
0001	PitWaterLevel	0.01 m
0002	PitSwitchWaterLevel	Unscaled
0003	PitFlowIn	0.1 litre/s
0004	PitAverageFlowIn	0.1 litre/s
0005	PitFlowOut	0.1 litre/s
0006	PitAverageFlowOut	0.1 litre/s
0007	PitPower	10 W*
0008	PitSpecificEnergy	1 Wh/m^3
0010	PitMixerStartPerH	Unscaled
0011	PitOutletPressure	0.001 bar
0012	PitEstimatedFlowOut	0.1 l/s
0500	UserAnalogInput1	0.1 %
0501	UserAnalogInput2	0.1 %
0502	UserAnalogInput3	0.1 %
1000	Pump1Flow	0.1 litre/s
1001	Pump1LatestFlow	0.1 litre/s
1002	Pump1Current	0.1 A
1003	Pump1Insulation	10 kΩ
1004	Pump1WaterInOil	0.1 %
1005	Pump1MotorTemperature1	1 °C
1006	Pump1MotorTemperature2	1 °C
1007	Pump1CosPhi	0.01
1008	Pump1Power	10 W*
1009	Pump1Voltage	0.1 V
1010	Pump1LatestCurrent	0.1 A
1011	Pump1StartsPerH	Unscaled
1012	Pump1LatestOperatingTime	1 s
1013	Pump1Frequency	0.01 Hz
1014	Pump1Torque	0.1 Nm
1015	Pump1CurrentAsymmmetry	0.1 %
2000	Pump2Flow	0.1 litre/s
2001	Pump2LatestFlow	0.1 litre/s
2002	Pump2Current	0.1 A
2003	Pump2Insulation	10 kΩ
2004	Pump2WaterInOil	0.1 %
2005	Pump2MotorTemperature1	1 °C
2006	Pump2MotorTemperature2	1 °C
2007	Pump2CosPhi	0.01
2008	Pump2Power	10 W*
2009	Pump2Voltage	0.1 V
2010	Pump2LatestCurrent	0.1 A
2011	Pump2StartsPerH	Unscaled
2012	Pump2LatestOperatingTime	1 s
2013	Pump2Frequency	0.01 Hz
2014	Pump2Torque	0.1 Nm
2015	Pump2CurrentAsymmmetry	0.1 %
3000	Pump3Flow	0.1 litre/s
3001	Pump3LatestFlow	0.1 litre/s
3002	Pump3Current	0.1 A
3003	Pump3Insulation	10 kΩ
3004	Pump3WaterInOil	0.1 %

Log series item No	Log item register	Scale
3005	Pump3MotorTemperature1	1 °C
3006	Pump3MotorTemperature2	1 °C
3007	Pump3CosPhi	0.01
3008	Pump3Power	10 W*
3009	Pump3Voltage	0.1 V
3010	Pump3LatestCurrent	0.1 A
3011	Pump3StartsPerH	Unscaled
3012	Pump3LatestOperatingTime	1 s
3013	Pump3Frequency	0.01 Hz
3014	Pump3Torque	0.1 Nm
3015	Pump3CurrentAsymmmetry	0.1 %
4000	Pump4Flow	0.1 litre/s
4001	Pump4LatestFlow	0.1 litre/s
4002	Pump4Current	0.1 A
4003	Pump4Insulation	10 kΩ
4004	Pump4WaterInOil	0.1 %
4005	Pump4MotorTemperature1	1 °C
4006	Pump4MotorTemperature2	1 °C
4007	Pump4CosPhi	0.01
4008	Pump4Power	10 W*
4009	Pump4Voltage	0.1 V
4010	Pump4LatestCurrent	0.1 A
4011	Pump4StartsPerH	Unscaled
4012	Pump4LatestOperatingTime	1 s
4013	Pump4Frequency	0.01 Hz
4014	Pump4Torque	0.1 Nm
4015	Pump4CurrentAsymmmetry	0.1 %
5000	Pump5Flow	0.1 litre/s
5001	Pump5LatestFlow	0.1 litre/s
5002	Pump5Current	0.1 A
5003	Pump5Insulation	10 kΩ
5004	Pump5WaterInOil	0.1 %
5005	Pump5MotorTemperature1	1 °C
5006	Pump5MotorTemperature2	1 °C
5007	Pump5CosPhi	0.01
5008	Pump5Power	10 W*
5009	Pump5Voltage	0.1 V
5010	Pump5LatestCurrent	0.1 A
5011	Pump5StartsPerH	Unscaled
5012	Pump5LatestOperatingTime	1 s
5013	Pump5Frequency	0.01 Hz
5014	Pump5Torque	0.1 Nm
5015	Pump5CurrentAsymmmetry	0.1 %
6000	Pump6Flow	0.1 litre/s
6001	Pump6LatestFlow	0.1 litre/s
6002	Pump6Current	0.1 A
6003	Pump6Insulation	10 kΩ
6004	Pump6WaterInOil	0.1 %
6005	Pump6MotorTemperature1	1 °C
6006	Pump6MotorTemperature2	1 °C
6007	Pump6CosPhi	0.01
6008	Pump6Power	10 W*
6009	Pump6Voltage	0.1 V
6010	Pump6LatestCurrent	0.1 A
6011	Pump6StartsPerH	Unscaled
6012	Pump6LatestOperatingTime	1 s
6013	Pump6Frequency	0.01 Hz

Log series item No	Log item register	Scale
6014	Pump6Torque	0.1 Nm
6015	Pump6CurrentAsymmmetry	0.1 %

* The data item PitPowerHI/LO (registers 00308 and 00309) has a resolution of 1 W, but the logging is in 10 W.

Log series max. limits	
Total number of samples	40000 registers
Log series max. length	8192 registers (max. value for LogSeriesNoOfSamples)
Maximum number of log series	64 (max. value for NoOfLogSeries (register 07001))

11.4 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 CU 36X control unit itself, to reflect the actual value used by the CU 36X.

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/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 CU 36X control unit is actually using.

Example 1

Setting and reading overflow level with ReadWriteSeparation disabled [default].

The user writes a new value to SetOverflowLevel (register 00121).

The resulting overflow level is then read from SetOverflowLevel (register 00121).

Note ***ReadWriteSeparation is disabled by default.***

Example 2

Setting and reading overflow level with ReadWriteSeparation enabled.

The user writes a new value to SetOverflowLevel (register 00121).

The resulting overflow level is then read from OverflowLevel (register 00240), hence separating reads from writes.

11.5 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.

Note ***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.

11.6 GSM call-up connection

The call-up function in the Dedicated Controls wastewater system is used for SCADA system communication via the GSM network. Connection is established when the SCADA system dials the CIM 250. The CIM 250 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, the CIM 250 will hang 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 the CIM 250, which also hangs up the line, and the call-up communication session is thereby completed. See fig. 18.

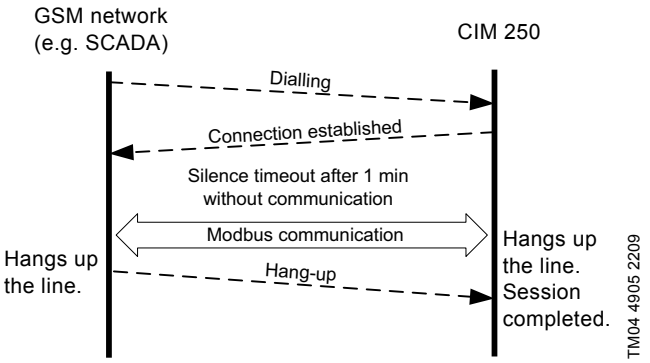


Fig. 18 Illustration of a GSM call-up session

If SCADA PIN code protection is enabled, the ScadaPinCode (register 00109) has to be written with the correct value before write access will be opened. It will then remain open until the call-up session is completed. The next call-up session also has to write the ScadaPinCode to be able to write registers.
See installation and operating instructions for Dedicated Controls.

Relevant settings in the CU 36X:

To find the parameter in the CU 36X, go to

Settings > Communication settings > SCADA settings >

- SCADA PIN code enabled
- SCADA PIN code.

11.7 GSM call-back connection

If an alarm appears in the Dedicated Controls wastewater system and the SCADA call-back function in the CU 36X has been enabled in general and also enabled for this particular alarm, the CIM 250 will attempt to establish a phone connection to the SCADA system. Dialling timeout is one minute, and if connection is not established, the CIM 250 will hang up and enter a call-back wait state. Call-back will be retried after one minute. This goes on forever as long as the alarm condition persists. See fig. 19.

If connection is established, the CIM 250 will wait up to one minute for data traffic. If no communication is initiated from the SCADA system, the CIM 250 will hang up, enter a call-back wait state and retry after one minute. See fig. 19.

The SCADA system is expected to start Modbus communication when called. When the appropriate data have been requested or written, the SCADA system must send a call-back acknowledgement to the CIM 250 to signal that it has received the information needed (Modbus writes to PitControl.CallBackAck, register 00101, bit 5). This is to prevent several call-backs based on the same event.

If SCADA PIN code protection is enabled, the ScadaPinCode (register 00109) has to be written with the correct value before write access will be opened. It will then remain open until the call-back session is completed.

To finally end the sequence, the SCADA system hangs up the line. This is detected by the CIM 250, which also hangs up the line, and the call-back communication session is thereby completed.

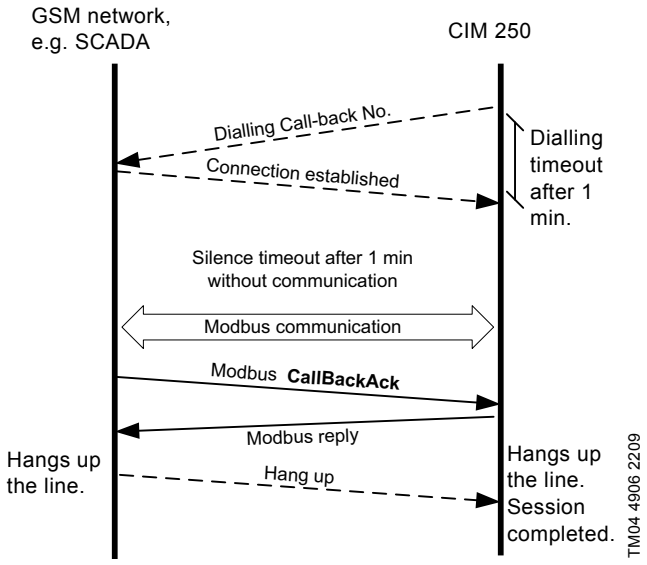


Fig. 19 Principle illustration of a call-back session

To find the parameter in the CU 36X, go to
Settings > Communication settings > SCADA settings >

- SCADA call-back enabled
- SCADA call-back phone number
- SCADA PIN code enabled
- SCADA PIN code.

Settings > Alarm settings >

- SCADA call-back enabled for particular alarms.

11.8 Use of SMS messages

The setting up and the use of the SMS functions are described in the installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 36X, go to
Settings > Communication settings >

- SMS numbers
- SMS schedule
- SMS heartbeat message
- SMS authentication.

Apart from the SMS functionality described in the previous sections which is related to the Dedicated Controls wastewater system, the CIM 250 will send SMS messages in case of faults or other special conditions of the CIM 250 itself.

Such messages do not depend on the CU 36X. They cannot be disabled, but are generated by the CIM 250 and sent to all numbers in the phone book.

Note

No SMS message will be sent if the phone book is empty (for instance if the CIM 250 has not been initialised).

The message is triggered by an event. If the CIM 250 is switched off and on (the battery must also be removed), it will send the message again if the cause of the message still exists.

11.8.1 No connection to product

If the communication between the CIM 250 and the CU 36X is interrupted for more than one minute, the CIM 250 will send this message to all numbers in the phone book.

[Installation name]
GSM Module Error:
No connection to product

Note

If the cause of the interruption is the fact that the power supply to the product was interrupted, the CIM 250 will send this message instead:
No mains supply, using battery. See below.

11.8.2 No mains supply, using battery

If the CIM 250 detects that it is being supplied from the optional CIM 250 battery, it will send this message to all numbers in the phone book:

[Installation name]
GSM Module Error:
No mains supply, using battery

This fault may disappear by itself, as the message is typically triggered by a short power cut. In case of this special fault (but not the other ones), the CIM 250 will send a message, telling that the fault has disappeared:

[Installation name]
GSM Module:
Mains supply returned

If the battery is worn out or the CIM 250 has no battery, the CIM 250 will not detect that the power supply to the CU 36X has been interrupted, as it will loose power supply itself. Therefore, it cannot send a message. To inform the user that there has been a power cut, the CIM 250 will always send an SMS message when the power supply has returned:

[Installation name]
GSM Module:
Power on occurred

11.8.3 Change GSM module battery

If the CIM 250 detects that the optional CIM 250 battery is worn out and must be replaced, it will send this message to all numbers in the phone book:

[Installation name]
GSM Module Error:
Change GSM Module battery

11.8.4 GSM module battery low

If the CIM 250 detects that the optional CIM 250 battery level is low, it will send this message to all numbers in the phone book:

[Installation name]
GSM Module Error:
GSM Module battery low

11.9 GPRS connection

GPRS (General Packet Radio Service) is a wireless, "allways on" connection that remains active as long as the CIM 250 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 32-48 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 to 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 below.

11.9.1 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 needs, 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) (e.g. "internet").
- Username (is fixed and cannot be changed by the user).
- 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, e.g. GRE routers, Generic Routing Encapsulation, which you will also get from the service provider.

11.9.2 Installation

Specific settings for GPRS communication in the CU 36X:

To find the parameter in the CU 36X, go to
Settings > Communication settings > GPRS settings >

- APN
- Username
- Password.

There are some advanced GPRS settings which have default values that usually work, but in special cases, it might be necessary to change some of them. This can only be done with the Grundfos PC Tool WW Controls:

- Authentication: "Normal"/"Secure" (only used by some service providers) (default is "Normal").
- Roaming: "Enabled"/"Disabled" (default is "Disabled").
- Modbus TCP port number (default 502).
- GENIpro port number (default 49152).

Other relevant settings in the CU 36X:

To find the parameter in the CU 36X, go to
Settings > Communication settings > SCADA settings >

- SCADA PIN code enabled
- SCADA PIN code.

11.9.3 Status

In the CU 36X display "Status > System > GSM/GPRS", you will see the following information:

- GPRS connection state
  - "Detached": No connection to any GPRS service.
  - "Attached": Connection to GPRS service established.
  - "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).
- Total GPRS data sent (in kb).
- Total GPRS data received (in kb).
- IP address (e.g. 218.214.34.201).

The same display also supplies statistical information about SMS messages, call-up connections and GSM signal strength.

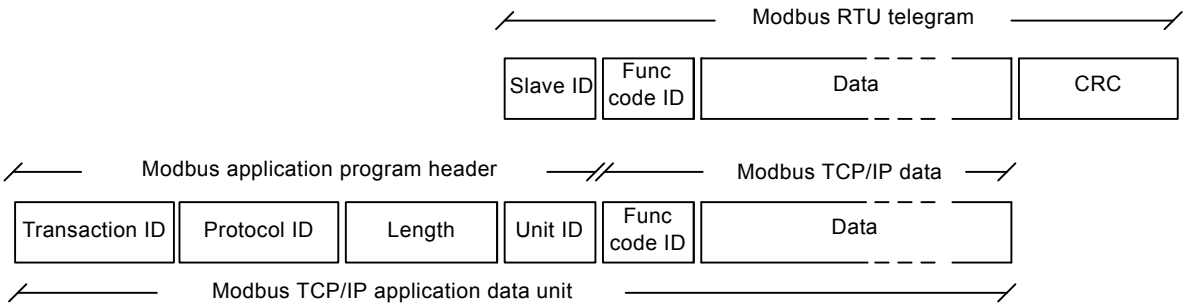


Fig. 20 Modbus TCP telegram

11.9.4 Operation

When powering on a CU 36X with the correct GSM/GPRS setting, the following GPRS connection sequence will take place:

1. The CIM 250 locates the GSM/GPRS service. The connection state changes from "Detached" to "Attached".
2. The CIM 250 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 the CIM 250. After the CIM 250 has got the IP address, the connection state changes to "Context active".
3. The CIM 250 is now ready for a client (e.g. SCADA system) to establish a socket connection and begin TCP/IP data exchange. When a client connects the CU 36X, 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*.

Note

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, e.g. SCADA, establishes connection to a CU 36X 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 the CU 36X is completely transparent.

The protection against unauthorised data access is high. The access to the GSM network from the internet can only take place via the VPN tunnel. See fig. 22. Moreover, data transfer requires a Modbus master client, knowledge of the Modbus functional profile and the use of a SCADA PIN code, if enabled.

The CIM 250 supervises the GPRS/GSM system to ensure that it is still working. An automatic procedure ensures restarting of the CIM 250 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 will increase.

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 the CU 36X and communicate simultaneously. Each connection, called a socket connection, is handled independently.

If all three sockets are used simultaneously, a "Silence timeout" of only 5 minutes is used to prevent a complete occupation for a long time.

If an alarm appears in the Dedicated Controls wastewater system and the SCADA call-back function in the CU 36X has been enabled in general and also enabled for this particular alarm, the CIM 250 will attempt to establish a GPRS connection to the SCADA system.

If the GPRS connection state is "Connected" (one or more socket connections are established), the call-back function in the CU 36X will use the GPRS connection and perform a GPRS call-back to all clients connected to port 502. Otherwise it will use a standard GSM call-back. See section *11.7 GSM call-back connection*.

A common standard for call-back via GPRS does not exist. In the CU 36X, this function is implemented as a Modbus TCP write telegram sent from the CIM 250. See fig. 21.

Transaction ID	0x**	Has the value of the latest transaction ID
	0x**	minus 10
Protocol ID	0x00	
	0x00	
Length	0x00	
	0x06	
Slave address	0xE7	Selected slave address, shown is default value
Function code	0x06	Write single register
Register address	0x01	
	0x00	
Value to write	0xFF	Value 0xFF00 written to register 0x0001
	0x00	

TM04 4909 2809

Fig. 21 Modbus TCP telegram used for call-back via GPRS

The call-back telegram is a "Write single register" function that writes the value of 0x00FF to a specific register address in the Modbus TCP master. Which register address to write to can be programmed in the ScadaGprsCallBackRegister (register 00007). In fig. 22 the address is 0x0001. The Modbus TCP master must interpret this as a call-back request from the CU 36X and start polling for data within one minute, otherwise the Modbus TCP write telegram will be resent.

The SCADA system must complete its communication with the CIM 250 by issuing a call-back acknowledgement.

If call-back is to be used, the SCADA system software (Modbus

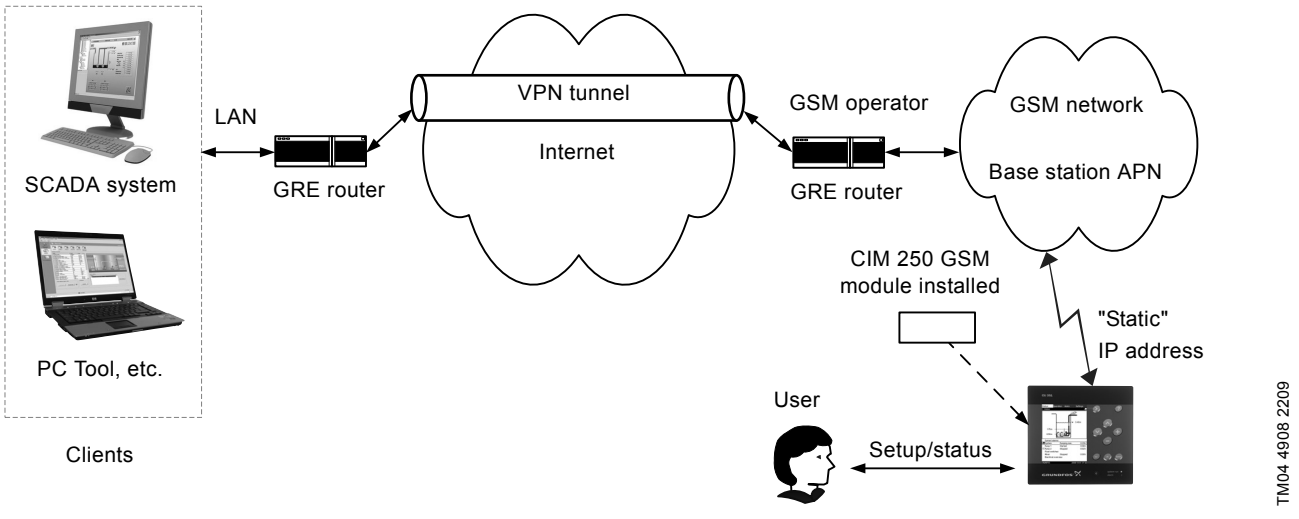


Fig. 22 GPRS via VPN tunnel

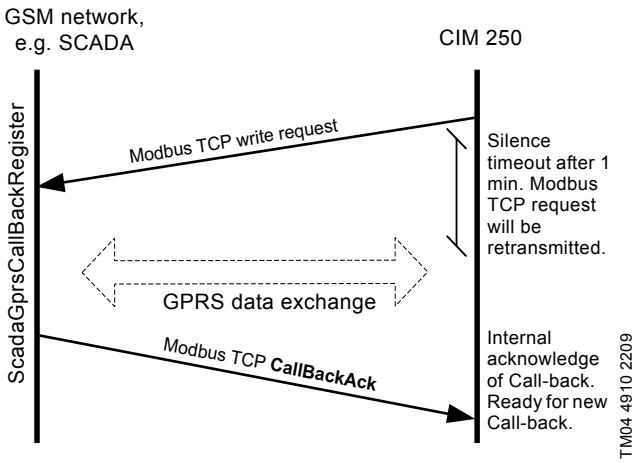


Fig. 23 GPRS call-back sequence

Relevant settings in the CU 36X:

To find the parameter in the CU 36X, go to

Settings > Communication settings > SCADA settings >

- SCADA call-back enabled.

Settings > Alarm settings > System alarms >

- SCADA call-back for particular alarms.

11.10 Interlocking

11.10.1 Interlocking from SCADA system via GSM/GPRS

Interlocking can be done from a Modbus master (like a SCADA system) via the Modbus interface.

To find the parameter in the CU 36X, go to

Settings > Communication settings > SCADA settings >

- SCADA PIN code (if PIN code protection is used).
- SCADA PIN code enabled/disabled.

Settings > Communication settings > Interlock settings >

- Incoming interlock enabled.

For further information, see installation and operating instructions for Dedicated Controls.

Interlocking procedure

1. The Modbus master (e.g. SCADA system or PLC) writes the correct SCADA PIN code to the ScadaPinCode (register 00109) if PIN code protection is enabled.

Note ***The SCADA system can verify that write access is granted by reading the PitStatus.WriteAccess (register 00202, bit 5) which will be logical 1 if write access is granted.***

2. The CU 36X Modbus slave verifies that the written ScadaPinCode (register 00109) register value corresponds to the SCADA PIN code entered by the user (CU 36X or PC Tool WW Controls). If the codes match, the slave will accept data writing from SCADA.
3. The Modbus master writes the InterlockTimeout (register 00226) if this value should be controlled from the master application. If it is not written, the existing value will be used.
4. The Modbus master raises the interlock bit PitControl.InterlockPit (register 00101, bit 3), which will bring the CU 36X into "interlock" mode. An interlock timeout is initiated, corresponding to the current value of the InterlockTimeout (register 00226) in the Modbus profile.

Note ***Whenever a rising edge PitControl.InterlockPit is generated, the interlock timeout will be reinitialised with the value of the InterlockTimeout register. This is used to prolong an interlock mode.***

5. The Modbus master can any time bring the CU 36X Modbus slave back into "Auto" mode by raising the PitControl.AutoPit, register 00101, bit 4.

11.10.2 Interlocking from another controller via SMS

Figure 11.13 illustrates the CU 36X SMS interlocking mechanism. The CU 36X interlock master issues an SMS command containing a 4-digit PIN code "pppp" matching the SMS PIN code of the interlock slave CU 36X. Following the PIN code is the interlock command "INTERLOCK" with an interlock timeout value mmmm counting in minutes. Timeout values allowed: 1-1440 min. (= 24 hours).

If the interlock is accepted (correct PIN code, correct command and valid interlock timeout value), the interlock slave will change its operating mode to "Interlock control".

The SMS PIN code in the interlock SMS command is optional if the authentication method is "Both" and the interlock master phone number is present in the interlock slave SMS phone number list.

The interlock timeout value, however, is always optional. If it is not included, the previously received value will be used.

By issuing the "Auto" command, the interlock master can instantly terminate interlocking: "pppp AUTO".

The function of interlocking by SMS has the natural consequence that interlocking is also possible via a mobile phone. In this case, the user will be able to see the acknowledgement SMS (positive or negative) replied back from the CU 36X.

The CU 36X interlock master can interlock up to three CU 36X interlock slaves, each represented by a set of parameters that have to be configured in the master for each of them.

To find the parameter in the CU 36X, go to

Settings > Communication settings > Interlock settings > Interlock, pit 1 >

- Outgoing interlock slave phone number
- Outgoing interlock SMS PIN code
- Outgoing interlock SMS PIN code enabled
- Outgoing interlock timeout.

The interlock slave has to be configured as described in the installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 36X, go to

Settings > Communication settings > SMS authentication >

- SMS PIN code `pppp`
- SMS authentication method ("Via phone number", "Via PIN code", "Both" or "None").

Settings > Communication settings > Interlock settings >

- Incoming interlock enabled.

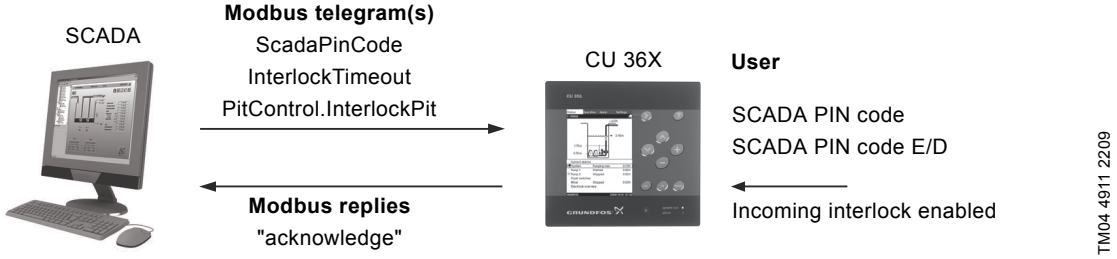


Fig. 24 Interlocking from SCADA

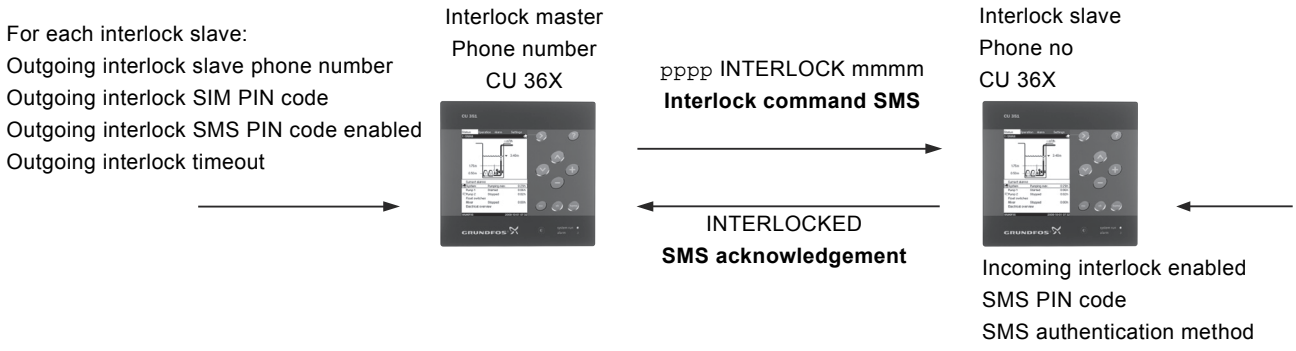


Fig. 25 Interlocking from another controller

11.11 Real-time clock

The real-time clock can be set and/or read from the CU 36X in two ways: Unix format or standard format.

All time stamps in the event log and in the data log are also Unix time format. Read the time with UNIXRealTimeClockHI (register 00228) and UNIXRealTimeClockLO (register 00229), or set a new time with SetRealTimeClockHI (register 00112) and SetRealTimeClockLO (register 00113). The new time will be activated in the CU 36X when writing the LO-order register. It is recommended to write the HI/LO registers in the same telegram.

11.11.1 Unix time format

For further information, see

- http://www.devshed.com/c/a/Administration/UNIX-Time_Format_Demystified/1/
- http://www.epochconverter.com/

11.11.2 Standard format

In the standard format, there are registers for specifying second, minute, hour, day, month and year (year, offset by 2000) in a human-readable way. With registers from 00230 to 00235 the actual values can be read, and with registers 00114 to 00119 new values can be set. The new values will be activated when writing the value "1" to SetRtc (register 00120, bit 0).

11.12 Event simulation

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

- SimulationEventCode (register 00701)
- SimulationEventSource (register 00702)
- SimulationEventDeviceNo (register 00703)
- SimulationEventActionType (register 00704).

Afterwards it is possible to trigger the simulated event via SimulationActivate (register 00705, bit 0). The event recording will take place as if the event was real, but the system operation will not be influenced.

The SimulationStatus (register 00706, bit 0) can be used to check if event simulation is active. If the bit value is 0, there is no active alarm simulation.

By writing a '0' to SimulationEventCode (register 00701) and afterwards setting the SimulationActivate (register 00705, bit 0) control bit, the simulated event is cancelled. It can also be cancelled with the PitControl.ResetAlarm (register 00101, bit 0) control bit.

Event simulation procedure

- Write a valid event code (see section *9.13 Alarm simulation register block*) to SimulationEventCode (register 00701).
- Write an event source number (see section *9.13 Alarm simulation register block*) to SimulationEventSource (register 00702).
- Write a device number (see section *9.13 Alarm simulation register block*) to SimulationEventDeviceNo (register 00703).
- Write an action type number (see section *9.13 Alarm simulation register block*) to SimulationEventActionType (register 00704).
- Activate the alarm simulation with the above settings by writing 1 to SimulationActivate (register 00705, bit 0).

11.13 Alarms and warnings

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

Note ***Warnings use the same bit interpretation as alarms.***

Description	Data item	Code	Event source
Pit alarms 1 (register 00210)			
Overflow alarm	PitAlarms1.0	192	System
High-level alarm	PitAlarms1.1	191	System
Alarm level alarm	PitAlarms1.2	190	System
Dry-running alarm	PitAlarms1.3	57	System
Mains supply fault	PitAlarms1.4	6	System
Level float switch sequence inconsistency	PitAlarms1.5	205	System
Inconsistency between float switches and sensor	PitAlarms1.6	204	System
Signal fault, level/pressure sensor	PitAlarms1.7	168	AI (level sensor)
Signal fault, flow sensor	PitAlarms1.8	169	AI (flow sensor)
Signal fault, power meter sensor	PitAlarms1.9	186	AI (power sensor)
Fault, mixer contactor feedback	PitAlarms1.10	221	DI (mixer contactor)
Communication fault, I/O module	PitAlarms1.11	226	IO 351B
CIM fault (Communication Interface Module)	PitAlarms1.12	159	Add-on CIM module
SIM card fault	PitAlarms1.13	160	Add-on CIM module
Communication fault, main system (SCADA)	PitAlarms1.14	15	System
Power-on notice	PitAlarms1.15	247	System
Pit alarms 2 (register 00211)			
Fault, battery/UPS	PitAlarms2.0	248	Battery/UPS
Hardware fault, type 1	PitAlarms2.1	72	CU 36X/IO 351B
Ethernet: No IP address from DHCP server	PitAlarms2.2	231	System
Ethernet: Auto-disabled due to misuse	PitAlarms2.3	232	System
Time for service, mixer	PitAlarms2.4	222	Mixer
Maximum number of mixer starts per hour exceeded	PitAlarms2.5	223	System
User-defined relay activated	PitAlarms2.6	246	CU 36X
External fault signal	PitAlarms2.8	3	System
Combi alarm No 1	PitAlarms2.9	227	System
Combi alarm No 2	PitAlarms2.10	227	System
Combi alarm No 3	PitAlarms2.11	227	System
Combi alarm No 4	PitAlarms2.12	227	System
Signal fault, user-defined sensor 1	PitAlarms2.13	188	User-defined sensor, analog input 1
Signal fault, user-defined sensor 2	PitAlarms2.14	188	User-defined sensor, analog input 2
Signal fault, user-defined sensor 3	PitAlarms2.15	188	User-defined sensor, analog input 3
Pit alarms 3 (register 00212)			
Discharge pressure sensor signal fault	PitAlarms3.0	168	AI (Pressure sensor)
Water on floor alarm	PitAlarms3.1	229	System
Gas detected alarm	PitAlarms3.2	235	System
Uster event 1 alarm	PitAlarms3.3	249	System
Uster event 2 alarm	PitAlarms3.4	250	System
Uster event 3 alarm	PitAlarms3.5	251	System
Uster event 4 alarm	PitAlarms3.6	252	System
RESERVED	PitAlarms3.7-15	-	-

Description	Data item	Code	Event source
Pump alarms 1 (registers 00423 (pump 1), 00473 (pump 2), 00523 (pump 3), 00573 (pump 4), 00623 (pump 5), 00673 (pump 6))			
Motor temperature alarm, PTC1	PumpAlarms1.0	69	IO 111, pump No [1; 6]
Motor temperature alarm, PTC2	PumpAlarms1.1	70	IO 351B/MP 204, pump No [1; 6]
Motor stator temperature high (T1, Pt1000/Pt100)	PumpAlarms1.2	64	IO 111, pump No [1; 6]
Motor stator temperature high (T2, Pt1000/Pt100)	PumpAlarms1.3	71	MP 204, pump No [1; 6]
Motor support bearing temperature high (Pt100)	PumpAlarms1.4	145	IO 111, pump No [1; 6]
Motor main bearing temperature high (Pt100)	PumpAlarms1.5	146	IO 111, pump No [1; 6]
Motor insulation resistance low	PumpAlarms1.6	20	IO 111, pump No [1; 6]
Motor low voltage (no voltage)	PumpAlarms1.7	40	MP 204, pump No [1; 6]
Motor high voltage	PumpAlarms1.8	32	MP 204, pump No [1; 6]
Motor phase sequence reversal	PumpAlarms1.9	9	MP 204, pump No [1; 6]
Motor overload (maximum current)	PumpAlarms1.10	48	AI/MP 204, pump No [1; 6]
Motor underload (minimum current)	PumpAlarms1.11	56	AI/MP 204, pump No [1; 6]
Motor protector test trip	PumpAlarms1.12	27	DI/MP 204, pump No [1; 6]
Motor missing phase	PumpAlarms1.13	2	MP 204, pump No [1; 6]
Motor current asymmetry	PumpAlarms1.14	111	MP 204, pump No [1; 6]
Load continues even if the motor relay is off	PumpAlarms1.15	26	MP 204, pump No [1; 6]
Pump alarms 2 (registers 00424 (pump 1), 00474 (pump 2), 00524 (pump 3), 00574 (pump 4), 00624 (pump 5), 00674 (pump 6))			
Motor protector commanded (test) trip	PumpAlarms2.0	18	MP 204, pump No [1; 6]
Common phase error	PumpAlarms2.1	241	DI, pump No [1; 6]
Motor moisture switch	PumpAlarms2.2	22	IO 111, pump No [1; 6]
Motor/pump vibration high	PumpAlarms2.3	24	IO 111, pump No [1; 6]
Motor water-in-oil content too high (water in oil)	PumpAlarms2.4	11	AI/IO 111, pump No [1; 6]
Motor fault in mains supply	PumpAlarms2.5	6	DI, pump No [1; 6]
Motor contactor feedback fault	PumpAlarms2.6	220	DI, pump No [1; 6]
Motor max. starts per hour limit exceeded	PumpAlarms2.7	21	System, pump No [1; 6]
Motor operating time service limit exceeded	PumpAlarms2.8	12	Pump No [1; 6]
Too many pump auto-restarts (per 24 h)	PumpAlarms2.9	4	MP 204, pump No [1; 6]
Pump low flow	PumpAlarms2.10	58	Pump No [1; 6]
Pump max. continuous runtime limit exceeded	PumpAlarms2.11	245	System, pump No [1; 6]
Motor cos φ too high	PumpAlarms2.12	112	MP 204, pump No [1; 6]
Motor cos φ too low	PumpAlarms2.13	113	MP 204, pump No [1; 6]
Pump alarms 3 (registers 00425 (pump 1), 00475 (pump 2), 00525 (pump 3), 00575 (pump 4), 00625 (pump 5), 00675 (pump 6))			
Pump malfunction due to auxiliary component fault	PumpAlarms3.0	224	Pump No [1; 6]
Communication fault, pump module	PumpAlarms3.1	225	IO 111, pump No [1; 6]
On/Off/Auto switch fault	PumpAlarms3.2	244	DI, pump No [1; 6]
Signal fault, Pt100 sensor	PumpAlarms3.3	175	IO 111/MP 204, pump No [1; 6]
Signal fault, PTC sensor	PumpAlarms3.4	181	IO 111, pump No [1; 6]
Signal fault, water-in-oil (WIO)	PumpAlarms3.5	170	AI, pump No [1; 6]
Signal fault, bearing temperature sensor (Pt100), general or top bearing	PumpAlarms3.6	179	IO 111, pump No [1; 6]
Signal fault, bearing temperature sensor (Pt100), middle bearing	PumpAlarms3.7	180	IO 111, pump No [1; 6]
Communication fault, pump	PumpAlarms3.8	10	IO 111, pump No [1; 6]
Setup conflict	PumpAlarms3.9	25	IO 111, pump No [1; 6]
General hardware fault	PumpAlarms3.10	72	IO 111/MP 204, pump No [1; 6]
Signal fault, motor current sensor	PumpAlarms3.11	88	AI, pump No [1; 6]
Inrush fault	PumpAlarms3.12	155	CUE, pump No [1; 6]
Signal fault, sensor 2	PumpAlarms3.13	93	CUE, pump No [1; 6]
Motor bearing temperature high (Pt100) in drive end (DE)	PumpAlarms3.14	148	CUE, pump No [1; 6]
Motor bearing temperature high (Pt100) in non-drive end (NDE)	PumpAlarms3.15	149	CUE, pump No [1; 6]

Description	Data item	Code	Event source
Pump alarms 4 (registers 00441 (pump 1), 00491 (pump 2), 00541 (pump 3), 00591 (pump 4), 00641 (pump 5), 00691 (pump 6))			
Leakage current	PumpAlarms4.0	1	CUE, pump No [1; 6]
Signal fault, temperature 3 sensor	PumpAlarms4.1	176	CUE, pump No [1; 6]
Signal fault, (feedback) sensor 1	PumpAlarms4.2	89	CUE, pump No [1; 6]
Overcurrent	PumpAlarms4.3	49	CUE, pump No [1; 6]
Motor current protection activated	PumpAlarms4.4	55	CUE, pump No [1; 6]
Change bearings	PumpAlarms4.5	30	CUE, pump No [1; 6]
Lubricate bearings	PumpAlarms4.6	240	CUE, pump No [1; 6]
Automatic motor model recognition failed	PumpAlarms4.7	242	CUE, pump No [1; 6]
Communication fault, twin-head pump	PumpAlarms4.8	77	CUE, pump No [1; 6]
Signal fault, temperature 1 sensor	PumpAlarms4.9	91	CUE, pump No [1; 6]
Dry running	PumpAlarms4.10	57	CUE, pump No [1; 6]
VFD not ready	PumpAlarms4.11	213	IO 351B, pump No [1; 6]
Other	PumpAlarms4.12	16	CUE, pump No [1; 6]

12. Modbus RTU telegram examples

Note

CRC fields are not shown in the following examples.

Note

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

12.1 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. 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.

Note

The CRC bytes are not shown in the examples in the following sections.

12.2 Read holding registers (0x03)

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

The request telegram specifies the starting address (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 0-16 are addressed as 0-15.

The register data in the response message are packed two bytes per register. For each register, the first byte contains the high-order bits while the second byte contains the low-order bits.

Example of request from master to 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 response from slave to 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.

12.3 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 (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 0-16 are addressed as 0-15.

The register data in the response message are packed two bytes per register. For each register, the first byte contains the high-order bits while the second byte contains the low-order bits.

Example of request from master to 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 slave to 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.

12.4 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 request from master to 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 response from slave to 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.

12.5 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 request from master to 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 response from slave to 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.

12.6 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 *12.7 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/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/restart).

Example of request from master to slave

Field	Value
Address	0x01
Function code	0x08
Subcode	0x00
Data	0xAB
Data	0xCD

The response is identical to the request.

Example of response from slave to master

Field	Value
Address	0x01
Function code	0x08
Subcode	0x00
Data	0xAB
Data	0xCD

12.7 Diagnostics register interpretation

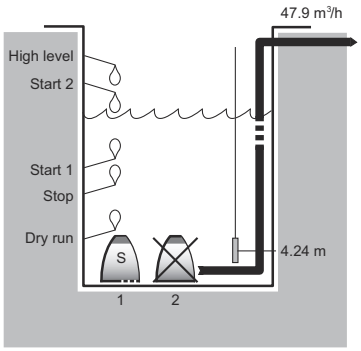
The diagnostics register is interpreted as follows:

Bit	Description
0	Communication failure (with the Grundfos product).
1	EEPROM self-test failed (the test is carried out when system is booted).
2	Grundfos product 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 true, unless otherwise specified.
The diagnostics register is read using function code 0x08 and subcode 0x02.

13. Application example

Pit operation	Pit status	Pump 1	Pump 2	Setup	Event log	Hour log	Data log



Alarm/warning

Grey	Pump OK.
Yellow	Pump warning.
Red	Pump alarm (device alarm or monitoring fault).

Run/stop

Grey	Pump not running.
Green	Pump running.

Manual

S	Switch.
D	Display.
R	Remote.

Setup: Opens a display for configuration of all the control levels.

Event log: Opens a display for viewing the SCADA event log.

Hour log: Opens a display for viewing the hourly logged values 3 days backwards.

Data log: Opens a display for viewing the configurable data log series.

Crossover: The pump has been disabled.

Pump 1

Operating mode: Start from switch	
Average flow	XXX.X m^3/h
Latest flow	XXXXX m^3/h
Starts total	XXXXX
Starts yesterday	XXXXX
Starts today	XXXXX
Starts per hour	XXXXX/h
Opr. time total	XXXXX/h : XX min.
Opr. time yesterday	XXXXX/h : XX min.
Opr. time today	XXXXX/h : XX min.
Latest opr. time	XXXXX/h : XX min.
Time to service	XXXXX/h

Motor

Temperature	XXX °C
Actual current	XXX.X A
Latest current	XXX.X A
Water in oil	XX.X %

Remote pump control

Active alarms/warnings

Alarms

None

Warnings

Water-in-oil sensor signal fault

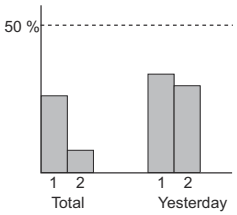
Pit status

Water level	XX.XX m
Pit depth	XX.XX m
Actual flow	XXX.XX m^3/h
Average flow	XXX.XX m^3/h
Power	XXX.XX kW
Energy total	XXXXXX kWh
Energy yesterday	XXXXXX kWh
Energy today	XXXXXX kWh
Specific energy	XX.XXX kWh/m^3
Operating time	XXXXX h : XX min.
Volume total	XXXXX m^3
Volume yesterday	XXXXX.X m^3
Volume today	XXXXX.X m^3
Mixer starts per hour	XXX.X /h

Overflow

Total volume	XXXXX m^3
Overflow time	XXXXX h
Number of overflows	XXXXX
Overflow volume yesterday	XXXXX m^3
Overflow time yesterday	XX h : XX min.
No. of overflows yesterday	XXX
Overflow volume today	XXXXX m^3
Overflow time today	XX h : XX min.
No. of overflows today	XXX

Opr. time, simultaneous opr. of two pumps



Active alarms/warnings

Alarms

None

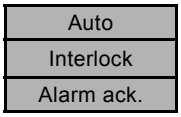
Warnings

None

Pit operation

Operating mode:

Interlock from SCADA



Custom relay

Time

Feb 26 2008 08.20

Fig. 26 Application example

13.1 Adaptation of pit graphics to installation values

- Pump object graphics (the shown register addresses are for pump 1):
  - Presence (pump object drawn or not) Pump#Status.Presence (register 00401, bit 0)
  - Disabled (cross marking) Pump#Status. Disabled (register 00401, bit 11)
  - Pumping mode (Running = green, Stopped = grey) Pump#Status.Running (register 00401, bit 1).
- Pump top colour (the shown register addresses are for pump 1):
  - Red if an alarm is present in Pump#Status.Alarm (register 00401, bit 4) or a monitoring fault (fault in auxiliary device) in Pump#Status.MonitoringFault (register 00401, bit 2)
  - Yellow if a warning is present in Pump#Status.Warning (register 00401, bit 3)
  - Grey if everything is OK for the pump in question.
- Pump control source (the shown register addresses are for pump 1): Pump#ControlSource (register 00402 [enum]). Letter marking of pump icon:
  - Auto = no marking
  - Switch = "S"
  - Display = "D"
  - Remote = "R".
- Number of float switches: NumberOfFloatSwitches (register 00217).
- Function of float switches 1 to 5:
  - FloatSwitch1Function (register 00219 [enum])
  - FloatSwitch2Function (register 00220 [enum])
  - FloatSwitch3Function (register 00221 [enum])
  - FloatSwitch4Function (register 00222 [enum])
  - FloatSwitch5Function (register 00223 [enum]).
- Displayed switch position:
  - Switch on (1) = up
  - Switch off (0) = down.
- Value of float switches 1 to 5: FloatSwitchesStatus (register 00218).
- Type of level and flow measurements: PitSensors (register 00224 [enum]).
- Water level: PitWaterLevel (register 00301 [0.01 m]) shown as a level sensor value and as a drawing of the water surface. If a level sensor is not present, the level can be expressed relative to the position of the installed float switches: PitSwitchWaterLevel (register 00302 [enum]).
- Flow value:
  - PitFlowOut (register 00306 [0.1 l/s]) or
  - PitAverageFlowOut (register 00307 [0.1 l/s]).

13.2 Main status

13.2.1 Pit operation display

Note

Before trying to operate the CU 361 control unit, remember to write the ScadaPinCode (register 00109) if PIN code protection has been enabled.

- Operating mode: OperatingMode (register 00203 [enum]).
- The "Interlock" button will issue the PitControl.InterlockPit (register 00101, bit 3) command, which brings the pit into operating mode "Interlocked", and the "Auto" button will issue the PitControl.AutoPit (register 00101, bit 4) command, which brings it back into one of the automation modes.
- The "Alarm Ack" button will issue the PitControl.ResetAlarm (register 00101, bit 0) command, which will clear any alarm/ warning indication (not logs) which does not represent a present alarm/warning condition, and will make the system assume automation control without any auto-acknowledgement delay.
- The "Custom relay" buttons are "radio buttons". Selecting "On" will issue the value 1 to data item SetCustomRelay (register 00102), and selecting "Off" will issue the value 0.
- Time (real-time clock in the CU 36X control unit):
  - Reading and displaying the time is done by using RealTimeClockHI/LO (register 00228/00229 [unix time]) or RtcSecond (register 00230), RtcMinute (register 00231), RtcHour (register 00232), RtcDay (register 00233), RtcMonth (register 00234), RtcYear (register 00235) if this time format is preferred.
  - The "Set time…" button opens a dialogue that can write the data item SetRealTimeClockHI/LO (register 00112/00113 [unix time]).

13.2.2 Pit status display

- Water level: PitWaterLevel (register 00301 [0.01 m]).
- Pit depth: PitDepth (register 00303 [0.01 m]).
- Actual flow: PitFlowOut (register 00306 [0.1 l/s]).
- Average flow: PitAverageFlowOut (register 00307).
- Total power consumption: PitPowerHI/LO (register 00308/00309 [1 W]).
- Total energy consumption: PitEnergyHI/LO (register 00310/00311 [0.1 kWh]).
- Energy consumption yesterday: PitEnergyYesterday (register 00312 [0.1 kWh]).
- Energy consumption today: PitEnergyToday (register 00313 [0.1 kWh]).
- Total pumping efficiency: PitSpecificEnergy (register 00314 [1 Wh/m^3]).
- Total operating time: PitOperatingTimeHI/LO (register 00329/00330 [1 min.]).
- Total pumped volume: PitPumpedVolumeHI/LO (register 00315/00316 [0.1 m^3]).
- Pumped volume yesterday: PitPumpedVolumeYesterday (register 00317 [0.1 m^3]).
- Pumped volume today: PitPumpedVolumeToday (register 00318 [0.1 m^3]).
- Number of mixer starts per hour: PitMixerStartsPerHour (register 00319).
- Total overflow volume: PitOverflowVolume (register 00320 [0.1 m^3]).
- Overflow volume yesterday (24 h): PitOverflowVolumeYesterday (register 00321 [0.1 m^3]).
- Overflow volume today: PitOverflowVolumeToday (register 00322 [0.1 m^3]).

- Total overflow time: PitOverflowTime (register 00323 [1 min.]).
- Overflow time yesterday (24 h): PitOverflowTimeYesterday (register 00324 [1 min.]).
- Overflow time today (24 h): PitOverflowTimeToday (register 00325 [1 min.]).
- Total number of overflows: PitOverflowCounter (register 00326).
- Number of overflows yesterday (24 h): PitOverflowCounterYesterday (register 00327).
- Number of overflows today (24 h): PitOverflowCounterToday (register 00328).
- One-pump operating time: (Pump1OprTimeHI/LO + Pump2OprTimeHI/LO - Pit2PumpsOprTimeHI/LO).
- Two-pump operating time (two pumps operating simultaneously): Pit2PumpsOprTimeHI/LO (register 00331/00332 [1 min.]).
- One-pump operating time yesterday (24 h): (Pump1OprTimeYesterday + Pump2OprTimeYesterday - Pit2PumpsOprTimeYesterday).
- Two-pump operating time yesterday (two pumps operating simultaneously): Pit2PumpsOprTimeYesterday (register 00333 [1 min.]).
- Calculation of relative operating times:
  - 1 pump = (Pump1OprTimeHI/LO + Pump2OprTimeHI/LO - Pit2PumpsOprTimeHI/LO) / PitOperatingTimeHI/LO (register 00329/00330)
  - 2 pumps = Pit2PumpsOprTimeHI/LO / PitOperatingTimeHI/LO.
- Active alarms and warnings:
  - PitAlarms1 (register 00210 [bits])
  - PitAlarms2 (register 00211 [bits])
  - PitAlarms3 (register 00212 [bits])
  - PitWarnings1 (register 00213 [bits])
  - PitWarnings2 (register 00214 [bits])
  - PitWarnings3 (register 00215 [bits]).

13.2.3 Pump status display

The data item registers mentioned below are for pump 1. Adding 50 to the register addresses will give you the equivalent register addresses for pump 2.

- Operating mode (Started, Stopped): Pump1Status.Running (register 00401, bit 1).
- Control source (Auto, Switch, Display, Remote): Pump1ControlSource (register 00402 [enum]).

Note ***The above information can be combined in a text like "Operating mode" from "Control source".***

- Average flow: Pump1Flow (register 00416 [0.1 l/s]).
- Latest measured flow: Pump1LatestFlow (register 00417 [0.1 l/s]).
- Total number of pump starts: Pump1StartCounterHI/LO (register 00411/00412).
- Number of pump starts yesterday (24 h): Pump1StartCounterYesterday (register 00413).
- Number of pump starts today: Pump1StartCounterToday (register 00414).
- Number of pump starts per hour: Pump1StartsPerHour (register 00415).
- Total operating time: Pump1OprTimeHI/LO (register 00404/00405 [1 min.]).
- Operating time yesterday (24 h): Pump1OprTimeYesterday (register 00408 [1 min.]).
- Operating time today: Pump1OprTimeToday (register 00409 [1 min.]).
- Latest operating time: Pump1LatestOprTime (register 00410 [1 s]).
- Time to service: Pump1TimeToServiceHI/LO (register 00406/00407 [1 min.]).
- Motor temperature: Pump1MotorTemperature1 (register 00429 [1 °C]).
- Motor current:
  - Pump1Current (register 00418 [0.1 A])
  - Pump1LatestCurrent (register 00419 [0.1 A]).
- Motor, water in oil: Pump1WaterInOil (register 00422 [0.1 %]).
- Commanding the pumps (Manual from Remote):
  - Stop will issue the value PitPump1Control (register 00103 [enum]) = 2, which brings the pump into operating mode Stop from Remote.
  - Start will issue the value PitPump1Control (register 00103 [enum]) = 1, which brings the pump into operating mode Start from Remote.
  - Auto will issue the value PitPump1Control (register 00103 [enum]) = 0, which brings the pump back into its previous state.
- See fig. 27 for logic and priority for the pump control, and note that the control sources "Switch" and "Display" have higher priority than Remote.

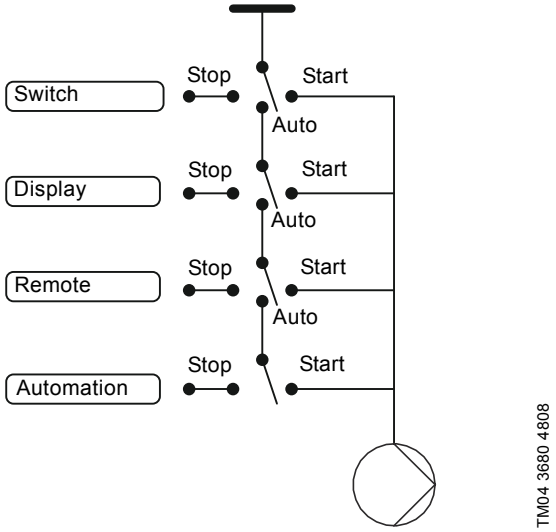


Fig. 27 Logic and priority for the pump control

Note ***Before trying to operate the pumps, remember to write the ScadaPinCode (register 00109) if PIN code protection has been enabled.***

- Active alarms and warnings:
  - Pump1Alarms1 (register 00423 [bits])
  - Pump1Alarms2 (register 00424 [bits])
  - Pump1Alarms3 (register 00425 [bits])
  - Pump1Warnings1 (register 00426 [bits])
  - Pump1Warnings2 (register 00427 [bits])
  - Pump1Warnings3 (register 00428 [bits]).

Display bar

The blue bar at the top of the screen is used to open and close specific displays that can show specific data and change settings of the pit control system.

The descriptions below refer to fig. 26.

- The "Pit operation" button opens the "Pit operation" display.
- The "Pit status" button opens the "Pit status" display.
- The "Pump 1" and "Pump 2" buttons open the "Pump 1" and "Pump 2" displays.
- The "Setup" button opens the display for showing and changing all the pump control levels. It might look as shown below.

Pumping control levels			
Overflow level	XXX cm	Cancel	Update
High level	XXX cm		
Alarm level	XXX cm		
Dry-running level	XXX cm		
Foam-draining level	XXX cm		

	Pump 1	**Pump 2**
Start level	XXX cm	XXX cm
Stop level	XXX cm	XXX cm

- Overflow level: SetOverflowLevel (register 00121 [0.01 m]).
- High level: SetHighLevel (register 00122 [0.01 m]).
- Alarm level: SetAlarmLevel (register 00123 [0.01 m]).
- Dry-running level: SetDryRunningLevel (register 00124 [0.01 m]).
- Foam-draining level: SetFoamDrainingLevel (register 00125 [0.01 m]).
- Start levels for pumps 1 and 2:
  – SetStartLevelPump1 (register 00126 [0.01 m])
  – SetStartLevelPump2 (register 00128 [0.01 m]).
- Stop levels for pumps 1 and 2:
  – SetStopLevelPump1 (register 00127 [0.01 m])
  – SetStopLevelPump2 (register 00129 [0.01 m]).

Note

These registers only reflect the actual values if the WriteSetup.ReadWriteSeparation (register 00006) bit is set to 0. Otherwise, reading back the actual values has to take place via the corresponding read-only registers, e.g. OverflowLevel (register 00240).

Note

Before trying to change the settings, remember to write the ScadaPinCode (register 00109) if PIN code protection has been enabled.

- The "Event log" button opens the display for showing a scrollable list of event records (alarms and warnings). The event log in the CU 36X contains the 50 latest events with the newest one at the top.

Each record takes up seven registers and has the following format:

<ID> <Code> <Description> <Source> <Type> <Time stamp>

The complete event log takes up 7 x 50 = 350 registers and is located in the register area register 06001 to 06351.

An *Event log* example is shown on page 71.

Event log

ID	Code	Description	Source	Type	Time
341	192	Overflow	System	Alarm appearing	05-08-2008 09:25
342	192	Overflow	System	Alarm disappearing	05-08-2008 11:09
343	222	Time for service, mixer	Mixer	Warning appearing	07-08-2008 02:38
344	6	Motor insulation resistance low	Pump 2	Warning appearing	11-08-2008 08:24

Note

The time stamp is in Unix time format. In the display example, it has been converted to a human-readable format.

Hour log

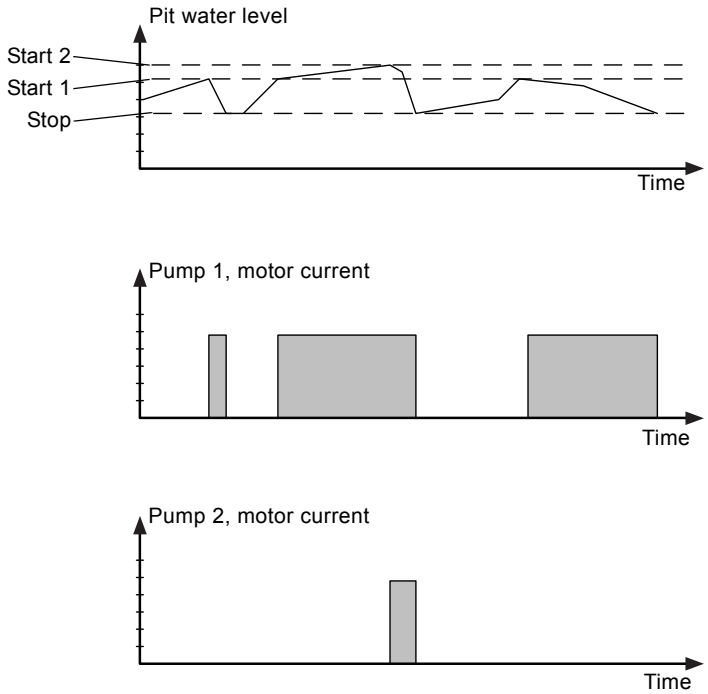
- The "Hour log" button opens the display for showing the hour log. The table below illustrates the structure of the data in the Modbus registers and a way of visualising them.

Data	Hour						Registers
	1	**2**	**3**	**…**	**71**	**72**	
Pit overflow time [min.]	0	4	6		0	0	02001-02072
Number of pit overflows	0	1	3		0	0	02073-02144
Overflow volume [0.1 m^3]	0	12	34		0	0	02145-02216
Specific energy [Wh/m^3]	240	262	198		308	287	02217-02288
Pumped volume [m^3]	67	69	72		45	23	02289-02360
Energy consumption [0.1 kWh]	342	456	514		178	123	02361-02432
Operating time (two pumps operating simultaneously) [min.]	8	20	48		0	4	02433-02504
Pump 1, operating time [min.]	23	56	60		14	12	02793-02864
Pump 1, number of starts	4	1	1		4	3	02865-02936
Pump 1, average flow [0.1 l/s]	452	468	458		433	446	02937-03008
Pump 1, average current [0.1 A]	252	248	241		240	242	03009-03080
Pump 2, operating time [min.]	21	52	63		15	11	03081-03152
Pump 2, number of starts	7	2	1		2	3	03153-03224
Pump 2, average flow [0.1 l/s]	458	451	471		438	444	03225-03296
Pump 2, average current [0.1 A]	250	239	240		229	240	03297-03368

Data Log

- The "Data log" button opens the display for showing the configurable data log.

The illustrations in fig. 28 show a way of visualising the pit water level, motor current for pump 1 and motor current for pump 2.



TM04 3429 4408

Fig. 28 Data logging

14. 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 *12.6 Diagnostics (0x08)* for subcodes.

Note ***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.

15. Modbus telegram examples

Note

CRC fields are not shown in the following examples.

Note

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

15.1 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 master to 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 response from slave to 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 *16.1.2 CIM 200 Modbus communication faults*.

15.2 Reading the CIM configuration register block

This section shows how to read the CIM configuration register block (a total of four registers).

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Start address HI	0x00	Start address = 0x0001
Start address LO	0x00	
Quantity HI	0x00	Number of registers = 0x0004
Quantity LO	0x04	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Byte count	0x08	8 bytes follow
00001 HI	0x0A	SlaveMinimumReplyDelay = 0x000A (10 ms)
00001 LO	0x00	
00002 HI	0x00	RegisterOffset = 0x0000 (no offset)
00002 LO	0x00	
00003 HI	0x00	Reserved value = 0x0000
00003 LO	0x00	
00004 HI	0x00	ModbusBitRate = 0x0004 (19200, software-defined)
00004 LO	0x04	

If there is no response from the slave, see section *16.1.2 CIM 200 Modbus communication faults*.

15.3 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 master to slave

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

Example of response from slave to 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 = 0x00DC (220)
00301 LO	0xDC	

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

If there is no response from the slave, see section *16.1.2 CIM 200 Modbus communication faults*.

15.4 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 209 = 0x00D1.

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Start address HI	0x00	Start address (00209) = 0x00D1
Start address LO	0xD0	
Quantity HI	0x00	Number of registers = 0x0003
Quantity LO	0x03	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x04	Read input registers
Byte count	0x06	6 bytes follow
00209 HI	0x00	Pit alarms 1
00209 LO	0x08	
00210 HI	0x00	Pit alarms 2
00210 LO	0x00	
00211 HI	0x00	Pit alarms 3
00211 LO	0x00	

If there is no response from the slave, see section *16.1.2 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.

15.5 Setting pit auto mode

This section shows how to set "Auto" mode in the CU 36X.

In the example, slave address 0x01 is used. Note that the register is reset by the CIM 200 when the command has been acknowledged. The value is only triggered on rising edge.

The register on address 00101 is set to the following:

Bit	Description
0	0 (do not reset)
1	0 (do not reset alarms)
2	0 (do not reset history)
3	0 (do not reset event log)
4	0 (do not interlock the pit)
5	**1 (set pit to "Auto" mode)**

Hence the value to set is 0b000000000100000 = 0x0020.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 32 (0x0020)
Value LO	0x20	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 32 (0x0020)
Value LO	0x03	

If there is no response from the slave, see section *16.1.2 CIM 200 Modbus communication faults*.

Note ***Writing control bits that are mutual exclusive may lead to unpredictable results.***

15.6 Interlocking the pit

This shows how to interlock the CU 36X.

In the example, slave address 0x01 is used. Note that the register is reset by the CIM 200 when the command has been acknowledged. The value is only triggered on rising edge.

The register on address 00101 is set to the following:

Bit	Description
0	0 (do not reset)
1	0 (do not reset alarms)
2	0 (do not reset history)
3	0 (do not reset event log)
4	**1 (interlock the pit)**
5	0 (set pit in "Auto" mode)

Hence the value to set is 0b0000000000010000 = decimal 16 = 0x0010.

Request from master to slave

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 16 (0x0010)
Value LO	0x10	

Example of response from slave to master

Field	Value	Description
Slave address	0x01	-
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 16 (0x0010)
Value LO	0x10	

If there is no response from the slave, see section *16.1.2 CIM 200 Modbus communication faults*.

16. Fault finding

16.1 Fault finding CIM 200

Faults in a CIM/ 200 can be detected by observing the status of the two communication LEDs. See the table below and section *4. Specifications*.

16.1.1 LED status

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIM 250 is fitted incorrectly in the CU 36X.	Ensure that the CIM 250 is fitted/connected correctly.
	b) The CIM 200 is defective.	Replace the CIM 200.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIM 200 and the Grundfos product.	Ensure that the CIM 200 is fitted correctly in the Grundfos CU36X.
3. The LED for internal communication (LED2) is constantly red.	a) The CIM 200 does not support the Grundfos product connected.	Contact the nearest Grundfos company.
4. The Modbus LED (LED1) is constantly 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, e.g. 19200 bits/s. • Check that the Modbus address (switches SW6 and SW7) has a valid value [1-247].
5. The Modbus LED (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 the CIM 200 and the Modbus network. • Check the termination resistor settings (switches SW1 and SW2). See section *5.4 Termination resistor*.

16.1.2 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 the CIM.	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.
	b) The register address offset may have been changed from default.	Read the holding register at address 00002 "Register Offset" to see if this value is different from 0. If so, write the value 0 to this address to make the slave return to the default used in this functional profile.
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 0004.	a) Configuration error.	Set the transmission speed switches to "Software-defined". (Otherwise, the value in register 0004 is 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.

16.2 Fault finding CIM 250

Faults in the CIM 250 can be detected by observing the status of the two communication LEDs. See the table below and section *3.3 Modbus GSM/GPRS (CIM 250)*.

16.2.1 LED status

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIM 250 is fitted incorrectly in the CU 36X.	Ensure that the CIM 250 is fitted/connected correctly.
	b) The CIM 250 is defective.	Replace the CIM 250.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CU36X and the Grundfos product.	Ensure that the CIM 250 is fitted correctly in the CU 36X.
3. The LED for internal communication (LED2) is constantly red.	a) The CIM 250 does not support the Grundfos product connected.	Contact the nearest Grundfos company.
4. The LED for GSM/GPRS communication (LED1) keeps flashing yellow. See signal 1 in fig. 13 on page 13.	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 e.g. a mobile phone. • Use an external antenna and experiment with the position.
5. The LED for GSM/GPRS communication is pulsating yellow with single pulse, but the CIM 250 cannot send or receive SMS messages.	a) The 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.

16.2.2 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 the CIM 250 has contact with the GSM network. The LED1 should 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 (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 the CIM 250.	See section *12. Modbus RTU telegram examples* 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 (e.g. 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) The 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 will trigger the write access control, and write access will be open, which can be verified with GeneralStatus, register 00029, bit 1 = 1.

16.3 Fault finding CIM 500

Faults in the CIM 500 can be detected by observing the status of the two communication LEDs. See the table below and section *4.4 CIM 500 Modbus TCP*.

16.3.1 LED status

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIM 250 is fitted incorrectly in the CU 36X.	Ensure that the CIM 250 is fitted/connected correctly.
	b) The CIM 500 is defective.	Replace the CIM 500.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIM 500 and the Grundfos product.	Check that the CIM 500 is fitted correctly in the Grundfos product.
3. The LED for internal communication (LED2) is permanently red.	a) The CIM 500 does not support the Grundfos product connected.	Contact the nearest Grundfos company.
4. The Ethernet LED (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 "A.4 Modbus TCP configuration" on page 87.
5. LED1 is permanently red and green at the same time.	a) Error in firmware download.	Use the Web server to download the firmware again.
6. LED2 is permanently red and green at the same time.	a) Memory fault.	Replace the CIM 500.

16.3.2 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 LED (LED2) is constantly green and that the Modbus TCP LED (LED1) is off or flashing green. If this is not fulfilled see section 16.3.1. • Ensure that the cable between the Modbus TCP master and the Modbus slave is connected correctly. See section 7.1. • 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.
2. The slave responds with exception response 0x01 "Invalid function"	The master is trying to use an unsupported function in the 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 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 a block of registers starting at address X is addressed as X - 1 in Modbus telegrams, according to the Modbus standard.
	b) The register address offset may have been changed from default.	Read the holding register at address 00002 "Register Offset" to see if this value is different from 0. If so, write the value 0 to this address to make the slave return to the default used in this functional profile.
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 react to control actions or to writing of settings.	The Grundfos product might be in "Local" mode, in which case Operating mode, Control mode and Setpoint cannot be changed from bus. Register 00201 bit 8 AccessMode must be "1" (=Remote) for bus control to be active.	Set the Grundfos product in "Remote mode" by setting register 00101 bit 0 RemoteAccessReq to "1" (=Remote). The Grundfos product should show "Controlled from bus" when status is read by handheld controllers R100 or GO Remote.

17. Modbus RTU rotary switch addresses

Modbus address	SW 6	SW 7
1	0	1
2	0	2
3	0	3
4	0	4
5	0	5
6	0	6
7	0	7
8	0	8
9	0	9
10	0	A
11	0	B
12	0	C
13	0	D
14	0	E
15	0	F
16	1	0
17	1	1
18	1	2
19	1	3
20	1	4
21	1	5
22	1	6
23	1	7
24	1	8
25	1	9
26	1	A
27	1	B
28	1	C
29	1	D
30	1	E
31	1	F
32	2	0
33	2	1
34	2	2
35	2	3
36	2	4
37	2	5
38	2	6
39	2	7
40	2	8
41	2	9
42	2	A
43	2	B
44	2	C
45	2	D
46	2	E
47	2	F
48	3	0
49	3	1
50	3	2

Modbus address	SW 6	SW 7
51	3	3
52	3	4
53	3	5
54	3	6
55	3	7
56	3	8
57	3	9
58	3	A
59	3	B
60	3	C
61	3	D
62	3	E
63	3	F
64	4	0
65	4	1
66	4	2
67	4	3
68	4	4
69	4	5
70	4	6
71	4	7
72	4	8
73	4	9
74	4	A
75	4	B
76	4	C
77	4	D
78	4	E
79	4	F
80	5	0
81	5	1
82	5	2
83	5	3
84	5	4
85	5	5
86	5	6
87	5	7
88	5	8
89	5	9
90	5	A
91	5	B
92	5	C
93	5	D
94	5	E
95	5	F
96	6	0
97	6	1
98	6	2
99	6	3
100	6	4

Modbus address	SW 6	SW 7
101	6	5
102	6	6
103	6	7
104	6	8
105	6	9
106	6	A
107	6	B
108	6	C
109	6	D
110	6	E
111	6	F
112	7	0
113	7	1
114	7	2
115	7	3
116	7	4
117	7	5
118	7	6
119	7	7
120	7	8
121	7	9
122	7	A
123	7	B
124	7	C
125	7	D
126	7	E
127	7	F
128	8	0
129	8	1
130	8	2
131	8	3
132	8	4
133	8	5
134	8	6
135	8	7
136	8	8
137	8	9
138	8	A
139	8	B
140	8	C
141	8	D
142	8	E
143	8	F
144	9	0
145	9	1
146	9	2
147	9	3
148	9	4
149	9	5
150	9	6

Modbus address	SW 6	SW 7
151	9	7
152	9	8
153	9	9
154	9	A
155	9	B
156	9	C
157	9	D
158	9	E
159	9	F
160	A	0
161	A	1
162	A	2
163	A	3
164	A	4
165	A	5
166	A	6
167	A	7
168	A	8
169	A	9
170	A	A
171	A	B
172	A	C
173	A	D
174	A	E
175	B	F
176	B	0
177	B	1
178	B	2
179	B	3
180	B	4
181	B	5
182	B	6
183	B	7
184	B	8
185	B	9
186	B	A
187	B	B
188	B	C
189	B	D
190	B	E
191	B	F
192	C	0
193	C	1
194	C	2
195	C	3
196	C	4
197	C	5
198	C	6
199	C	7
200	C	8

Modbus address	SW 6	SW 7
201	C	9
202	C	A
203	C	B
204	C	C
205	C	D
206	C	E
207	C	F
208	D	0
209	D	1
210	D	2
211	D	3
212	D	4
213	D	5
214	D	6
215	D	7
216	D	8
217	D	9
218	D	A
219	D	B
220	D	C
221	D	D
222	D	E
223	D	F
224	E	0
225	E	1
226	E	2
227	E	3
228	E	4
229	E	5
230	E	6
231	E	7
232	E	8
233	E	9
234	E	A
235	E	B
236	E	C
237	E	D
238	E	E
239	E	F
240	F	0
241	F	1
242	F	2
243	F	3
244	F	4
245	F	5
246	F	6
247	F	7

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

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

Caution

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.

18. Grundfos alarm and warning codes

This is a general Grundfos alarm and warning code list. Not all codes apply to all Grundfos products.

Code	Description	Code	Description	Code	Description
1	Leakage current	36	Discharge valve leakage	77	Communication fault, twin-head pump
2	Missing phase	37	Suction valve leakage	78	Fault, speed plug
3	External fault signal	38	Vent valve defective	79	Functional fault, add-on module
4	Too many restarts	40	Undervoltage	80	Hardware fault, type 2
5	Regenerative braking	41	Undervoltage transient	81	Verification error, data area (RAM)
6	Mains fault	42	Cut-in fault (dV/dt)	82	Verification error, code area (ROM, FLASH)
7	Too many hardware shutdowns	45	Voltage asymmetry	83	Verification error, FE parameter area (EEPROM)
8	PWM switching frequency reduced	48	Overload	84	Memory access error
9	Phase sequence reversal	49	Overcurrent (i_line, i_dc, i_mo)	85	Verification error, BE parameter area (EEPROM)
10	Communication fault, pump	50	Motor protection function, general shutdown (mpf)	88	Sensor fault
11	Water-in-oil fault (motor oil)	51	Blocked motor/pump	89	Signal fault, feedback sensor 1
12	Time for service (general service information)	52	Motor slip high	90	Signal fault, speed sensor
13	Moisture alarm, analog	53	Stalled motor	91	Signal fault, temperature 1 sensor
14	Electronic DC-link protection activated (ERP)	54	Motor protection function, 3 sec. limit	92	Calibration fault, feedback sensor
15	Communication fault, main system (SCADA)	55	Motor current protection activated (MCP)	93	Signal fault, sensor 2
16	Other	56	Underload	94	Limit exceeded, sensor 1
17	Performance requirement cannot be met	57	Dry running	95	Limit exceeded, sensor 2
18	Commanded alarm standby (trip)	58	Low flow	96	Setpoint signal outside range
19	Diaphragm break (dosing pump)	59	No flow	97	Signal fault, setpoint input
20	Insulation resistance low	60	Low input power		
21	Too many starts per hour	64	Overtemperature	98	Signal fault, input for setpoint influence
22	Moisture switch alarm, digital	65	Motor temperature 1 (t_m or t_mo or t_mo1)	99	Signal fault, input for analog setpoint
23	Smart trim gap alarm	66	Temperature, control electronics (t_e)	104	Software shutdown
24	Vibration	67	Temperature too high, internal frequency converter module (t_m)	105	Electronic rectifier protection activated (ERP)
25	Setup conflict	68	External temperature/water temperature (t_w)	106	Electronic inverter protection activated (EIP)
26	Load continues even if the motor has been switched off	69	Thermal relay 1 in motor (e.g. Klixon)	110	Skew load, electrical asymmetry
27	External motor protector activated (e.g. MP 204)	70	Thermal relay 2 in motor (e.g. thermistor)	111	Current asymmetry
28	Battery low	71	Motor temperature 2 (Pt100, t_mo2)	112	Cos φ too high
29	Turbine operation (impellers forced backwards)	72	Hardware fault, type 1	113	Cos φ too low
30	Change bearings (specific service information)	73	Hardware shutdown (HSD)	120	Auxiliary winding fault (single-phase motors)
31	Change varistor(s) (specific service information)	74	Internal supply voltage too high	121	Auxiliary winding current too high (single-phase motors)
32	Overvoltage	75	Internal supply voltage too low	122	Auxiliary winding current too low (single-phase motors)
35	Gas in pump head, deaerating problem	76	Internal communication fault	123	Start capacitor, low (single-phase motors)

Code	Description	Code	Description	Code	Description
124	Run capacitor, low (single-phase motors)	179	Signal fault, bearing temperature sensor (Pt100), general or top bearing	213	VFD not ready
144	Motor temperature 3 (Pt100, t_mo3)	180	Signal fault, bearing temperature sensor (Pt100), middle bearing	214	Water shortage, level 2
145	Bearing temperature high (Pt100), in general or top bearing	181	Signal fault, PTC sensor (short-circuited)	215	Soft pressure build-up timeout
146	Bearing temperature high (Pt100), middle bearing	182	Signal fault, bearing temperature sensor (Pt100), bottom bearing	216	Pilot pump alarm
147	Bearing temperature high (Pt100), bottom bearing	183	Signal fault, extra temperature sensor	217	Alarm, general-purpose sensor high
148	Motor bearing temperature high (Pt100) in drive end (DE)	184	Signal fault, general-purpose sensor	218	Alarm, general-purpose sensor low
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	185	Unknown sensor type	219	Pressure relief not adequate
152	Communication fault, add-on module	186	Signal fault, power meter sensor	220	Fault, motor contactor feedback
153	Fault, analog output	187	Signal fault, energy meter	221	Fault, mixer contactor feedback
154	Communication fault, display	188	Signal fault, user-defined sensor	222	Time for service, mixer
155	Inrush fault	189	Signal fault, level sensor	223	Maximum number of mixer starts per hour exceeded
156	Communication fault, internal frequency converter module	190	Sensor limit 1 exceeded (e.g. alarm level in WW application)	224	Pump fault (due to auxiliary component or general fault)
157	Real-time clock out of order	191	Sensor limit 2 exceeded (e.g. high level in WW application)	225	Communication fault, pump module
158	Hardware circuit measurement fault	192	Sensor limit 3 exceeded (e.g. overflow level in WW application)	226	Communication fault, I/O module
159	CIM fault (Communication Interface Module)	193	Sensor limit 4 exceeded	227	Combi event
160	GSM modem, SIM card fault	194	Sensor limit 5 exceeded	228	Not used
161	Sensor supply fault, 5 V	195	Sensor limit 6 exceeded	229	Not used
162	Sensor supply fault, 24 V	196	Operation with reduced efficiency	230	Network alarm
163	Measurement fault, motor protection	197	Operation with reduced pressure	231	Ethernet: No IP address from DHCP server
164	Signal fault, Liqtec sensor	198	Operation with increased power consumption	232	Ethernet: Auto-disabled due to misuse
165	Signal fault, analog input 1	199	Process out of range (monitoring/ estimation/calculation/control)	233	Ethernet: IP address conflict
166	Signal fault, analog input 2	200	Application alarm	236	Pump 1 fault
167	Signal fault, analog input 3	201	External sensor input high	237	Pump 2 fault
168	Signal fault, pressure sensor	202	External sensor input low	238	Pump 3 fault
169	Signal fault, flow sensor	203	Alarm on all pumps	239	Pump 4 fault
170	Signal fault, water-in-oil (WIO) sensor	204	Inconsistency between sensors	240	Lubricate bearings (specific service information)
171	Signal fault, moisture sensor	205	Level float switch sequence inconsistency	241	Motor phase failure
172	Signal fault, atmospheric pressure sensor	206	Water shortage, level 1	242	Automatic motor model recognition failed
173	Signal fault, rotor position sensor (Hall sensor)	207	Water leakage	243	Motor relay has been forced (manually operated/commanded)
174	Signal fault, rotor origo sensor	208	Cavitation	244	Fault, On/Off/Auto switch
175	Signal fault, temperature 2 sensor	209	Non-return valve fault	245	Pump continuous runtime too long
176	Signal fault, temperature 3 sensor	210	High pressure	246	User-defined relay has been forced (manually operated/ commanded)
177	Signal fault, smart trim gap sensor	211	Low pressure	247	Power-on notice (device/system has been switched off)
178	Signal fault, vibration sensor	212	Diaphragm tank precharge pressure out of range	248	Fault, battery/UPS

The appendix describes the parts of the CIM 500 web server needed for the configuration of a Modbus TCP Ethernet connection. For other CIM 500 web server features, not specifically related to Modbus TCP, see the CIM 500 Installation & Operating instructions.

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

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

1. Open "Control Panel".
2. Enter "Network and Sharing Center".
3. Click [Change adapter settings].
4. Right-click and select "Properties" for Ethernet adapter. Typically "Local Area Connection".
5. Select properties for "Internet Protocol Version 4(TCP/IPv4).
6. Select tab "Alternate Configuration".
7. Configure an IP address and subnet mask to be used by your PC. See fig. 29.

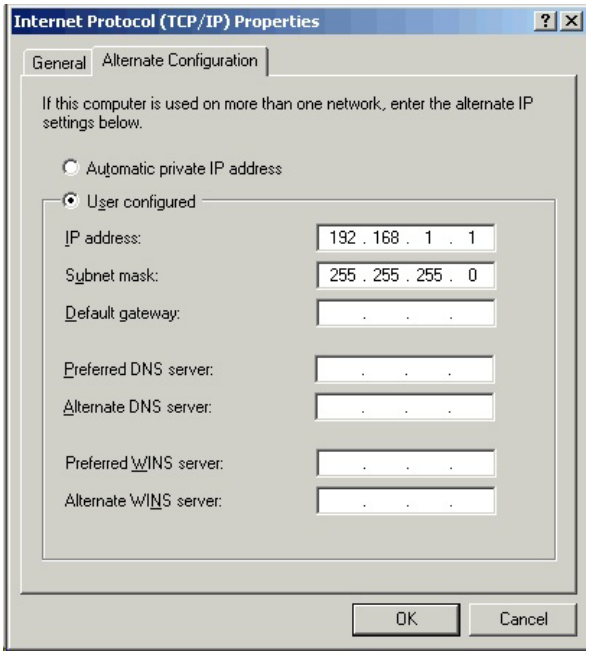


Fig. 29 Example from Windows XP

A.2 Web server configuration

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

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

Before configuration

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

To establish a connection from a PC to the 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 Web server.

A.3 Login

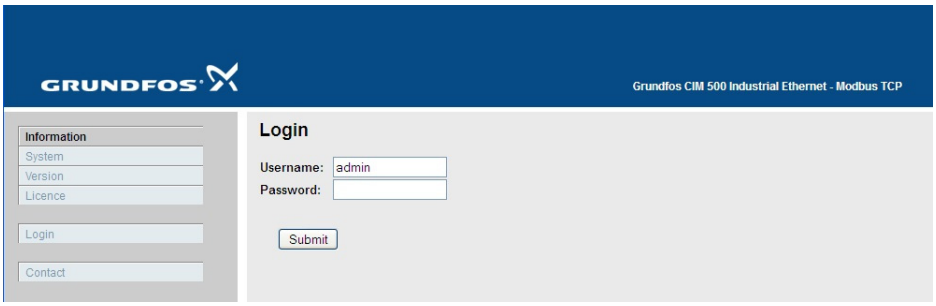


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Fig. 30 Login

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

Note ***User name and password can be changed on the web server under "Grundfos Management"***

A.4 Modbus TCP configuration

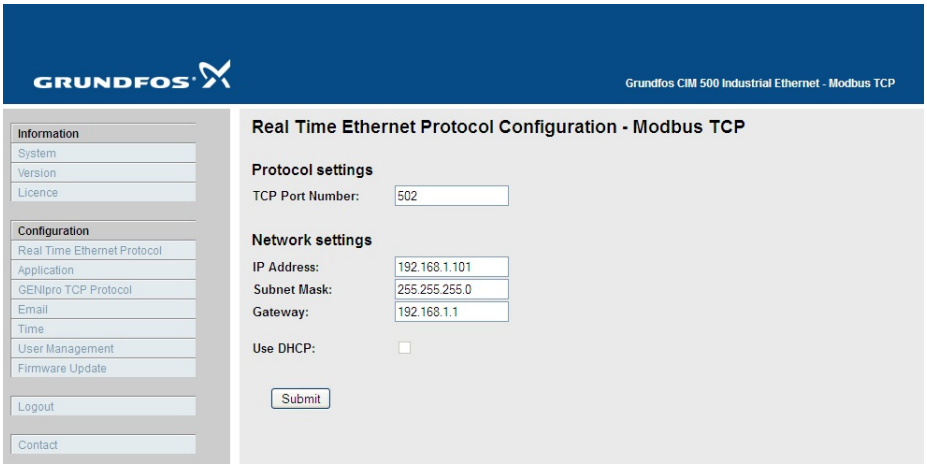

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Fig. 31 Real Time Ethernet Protocol Configuration - Modbus TCP

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 Web server 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 the CIM 500 module on the Modbus TCP network.
Gateway	The default gateway for the Modbus TCP network.
Use DHCP	The CIM 500 module can be configured to automatically obtain the IP address from a DHCP server on the network.

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