Installation and User Guide

EN

Labcom 442

Communication Unit

Installation and User's Guide (230 VAC)

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Labkotec

Contents

1 Background

The Labcom 442 communication unit is designed for the remote monitoring of measurements in industrial, domestic and environmental maintenance applications. Typical applications include oil separator alarms, tank surface level measurements, monitoring pumping stations and real estate, and surface and groundwater measurements.

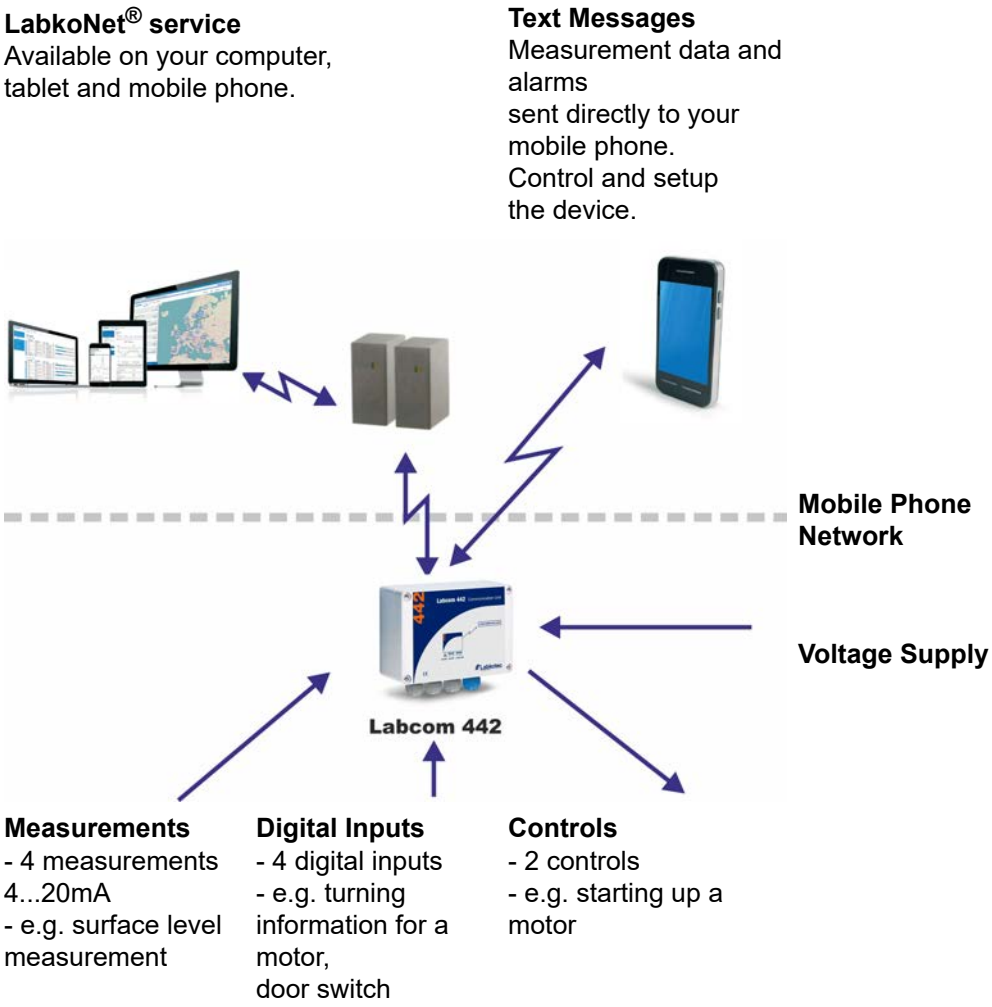


Figure 1: Labcom 442's connections to various systems

The device sends alarms and measurement results as text messages either directly to your mobile phone or to the LabkoNet service to be stored and distributed to other interested parties. You can easily modify the device settings with your mobile phone or by using LabkoNet service.

The Labcom 442 communication unit is available in two versions with different supply voltages. For continuous measurements, and generally when a permanent power supply is available, the natural choice for the supply voltage is 230 VAC. The device is also available with a battery backup in case of power outages.

The other version operates on a 12 VDC supply voltage and is designed for applications including surface and groundwater measurements, where the operating voltage comes from a battery. The device can be put into a mode that consumes extremely little electricity, allowing even a small battery to last as long as a year. Power consumption depends on the set measurement and transmission intervals. Labkotec offers also Labcom 442 Solar for solar powered service.

This installation and user's guide includes instructions for the installation, start-up and use of the 230 VAC version.

2 General information about the manual

This manual is an integral part of the product.

- Please read the manual before using the product.
- Keep the manual available for the entire duration of the product's life span.
- Provide the manual to the next owner or user of the product.
- Please report any errors or discrepancies related to this manual before commissioning the device.

2.1 Conformity of the product

The EU declaration of conformity and the product's technical specifications are integral parts of this document.

All of our products have been designed and manufactured with due consideration to the essential European standards, statutes and regulations.

Labkotec Oy has a certified ISO 9001 quality management system and ISO 14001 environmental management system.

2.2 Used Symbols

Safety related Signs and Symbols

DANGER!
This symbol indicates a warning about a possible fault or danger. In case of ignoring the consequences may range from personal infury to death.

WARNING!
This symbol indicates a warning about a possible fault or danger. In case of ignoring the consequences may cause personal injury or damage to the property.

CAUTION!
This symbol warns of a possible fault. In case of ignoring the device and any connected facilities or systems may be interrupted or fail complete.

Informative Symbols

Note!
This symbol brings important information to your attention.

This mark means that special attention must be paid to the installation, especially in potentially explosive atmospheres.

This mark means that the device is protected by double or reinforced insulation.

This marker indicates an action by the user.

2.3 Limitation of liability

Due to continuous product development, we reserve the right to change these operating instructions.

The manufacturer cannot be held liable for direct or indirect damage caused by neglecting the instructions provided in this manual or directives, standards, laws and regulations regarding the installation location.

The copyrights to this manual are owned by Labkotec Oy.

3 Safety and the environment

3.1 General safety instructions

The plant owner is responsible for the planning, installation, commissioning, operation, maintenance and disassembly at the location.

Installation and commissioning of the device may be performed by a trained professional only.

Protection of operating personnel and the system is not ensured if the product is not used in accordance with its intended purpose.

Laws and regulations applicable to the usage or intended purpose of the device must be observed. The device has been approved for the intended purpose of use only. Neglecting these instructions will void any warranty and absolve the manufacturer from any liability.

The device must be de-energised when any installation work is carried out.

Appropriate tools and protective equipment must be used during installation. Other risks at the installation site must be taken into account as appropriate.

3.2 Data security

The Labcom 442 may be configured by sending text messages to the device from the specified operator phone numbers. Treat the phone number of the Labcom 442 and the operator phone numbers as secrets (cf. password). Do not share the aforementioned information unless it is necessary. Remember to set the operator phone number(s) for the device when commissioning the device. After this, the device settings may only be changed via the specified phone numbers.

For more information, see the section *End user and operator phone numbers* 4 .

3.3 Maintenance

The device must not be cleaned with caustic fluids.

The device is maintenance-free. However, to quarantee perfect operation of the complete alarm system, check the operation at least once a year.

3.4 Transport and storage

Check the packaging and its content for any possible damage.

Ensure that you have received all the ordered products and that they are as intended.

Keep the original package. Always store and transport the device in the original packaging.

Store the device in a clean and dry space. Observe the permitted storage temperatures. If the storage temperatures have not been presented separately, the products must be stored in conditions that are within the operating temperature range.

3.5 Repair

The device may not be repaired or modified without the manufacturer’s permission. If the device exhibits a fault, it must be delivered to the manufacturer and replaced with a new device or one repaired by the manufacturer.

3.6 Decommissioning and disposal

The device must be decommissioned and disposed of in compliance with local laws and regulations.

4 Installation

4.1 Structure and installation of the unit enclosure

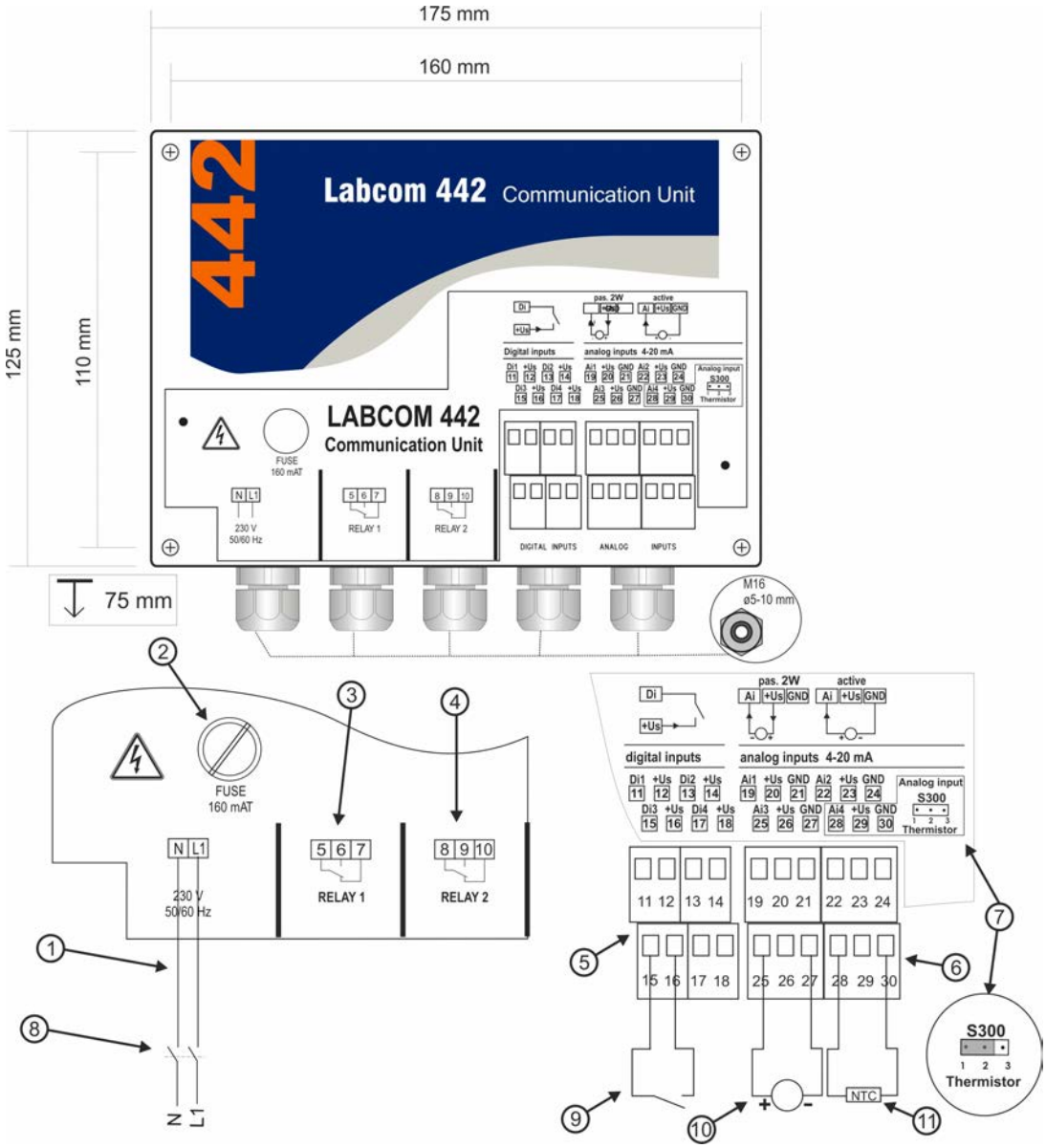
The Labcom 442 unit enclosure is wall-mounted. The installation holes are located at the bottom of the enclosure, under the mounting holes for the cover.

The power supply and relay connectors are located under the guard plate. The guard plate must be removed for the duration of the connection work and reinstalled after all cables have been connected. The terminals for external connections are separated by partitions. The partitions must not be removed.

The cover of the enclosure must be tightened so that the edges touch the bottom part. The enclosure class is IP65. Extra lead-throughs must be plugged before the device is used.

⚠ The device includes a radio transmitter.

When selecting the installation location, you must take into account that a minimum distance of 0.5 cm must be maintained between the user's body and the device, including the antenna, when the device is being carried, in order for the device to comply with the European safety requirements for exposure to RF.



1. VOLTAGE SUPPLY 230 VAC, 50/60Hz
L1 = mains connection phase conductor
N = mains connection neutral conductor
2. FUSE 160 mAT
3. RELAY 1
5 = common contact
6 = normally open contact
7 = normally closed contact

4. RELAY 2
8 = common contact
9 = normally open contact
10 = normally closed contact
5. DIGITAL INPUTS
4 pcs, terminals 11–18
6. ANALOGUE INPUTS
4 pcs, terminals 19–30
Analogue input 4, set jumper S300 to 2–3.

7. TEMPERATURE MEASUREMENT SELECTION
Connect temperature measurement to analogue input 4
and set jumper S300 to 1–2.
8. Isolating switch
9. Digital input 3
10. Active sensor
11. Temperature measurement
Installation dimensions 160 mm x 110 mm

Figure 2: Structure and connections

4.2 Connecting the sensors

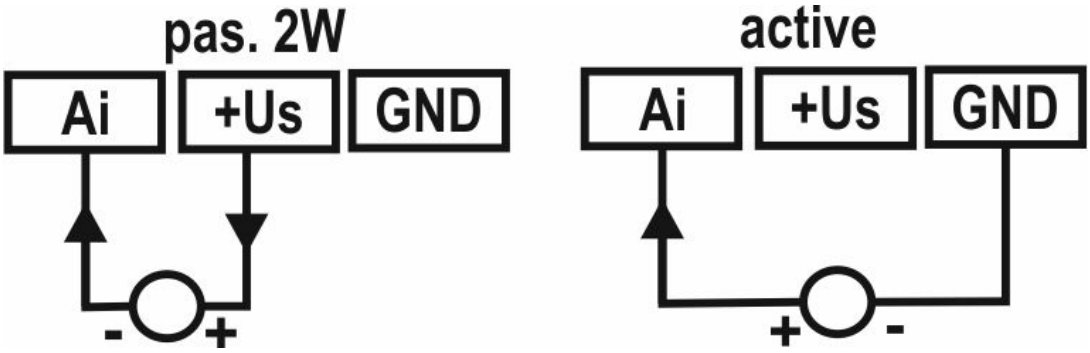


Figure 3: Connecting the sensors

The Labcom 442 has four 4–20 mA analogue inputs.

A supply voltage of around 24 VDC (+Us) is available from the device for a passive two-wire transmitter (pas. 2W). The input impedance is 130–180 Ω for channels 1 to 3 and 150–200 Ω for channel 4.

Alternatively, you can connect an active power transmitter that obtains its supply voltage from some other system to the analogue input.

4.3 Connecting the supply voltage

The supply voltage of the mains version is +/-10% 230 V 50/60 Hz. The maximum connected load is 18 VA. The voltage is applied to the line terminal marked L1 and N (see figure 2). The supply should preferably be taken as a separate group from the distribution centre. The device is equipped with a mains fuse 200 mAT [5 x 20 mm, glass tube].

NOTE! An isolating switch (250 VAC / 1A) must be installed on the supply voltage conductors, close to the appliance, to separate the two conductors (L1, N) to facilitate maintenance and operation. The switch shall be marked as the isolating switch for the equipment. A standard plug is acceptable as a disconnect switch.

4.3.1 Battery backup

The device is also available with battery backup in case of power outages. The battery is connected to the connector at the top of the device. Secure the battery to the cover of the enclosure with a two-sided sticker as shown in figure 4 .

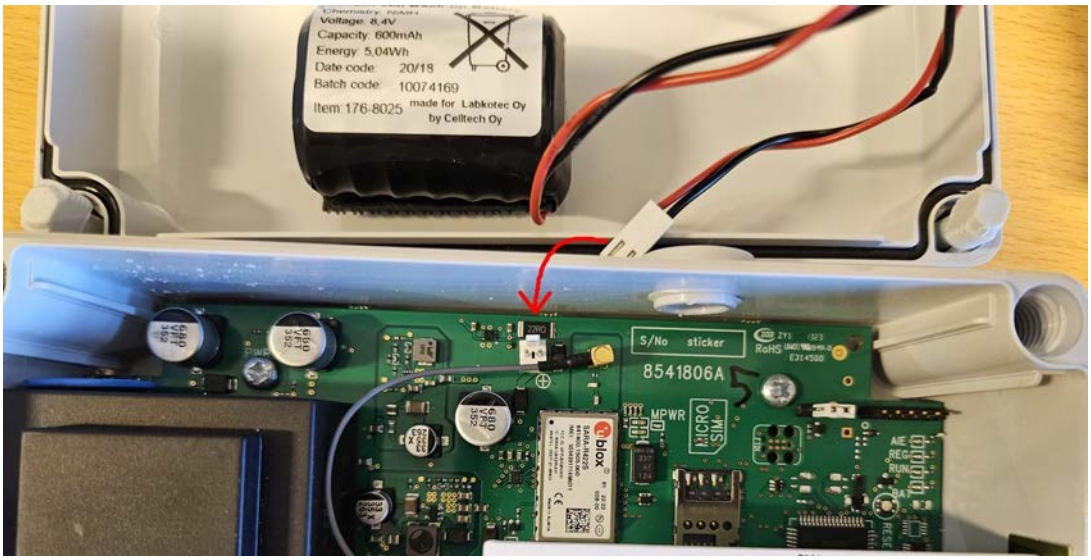


Figure 4: Connecting the Labcom 442 battery backup

The Labcom 442 constantly charges the battery at a low current, always keeping the battery in operating condition. If a power outage occurs, the Labcom 442 will send the alarm message ***'Power Failure'*** to the set phone numbers or LabkoNet and will continue operating for one to four hours, depending on the number of measurements connected to the device and the ambient temperature.

Once supply voltage is restored, the device will send the message ***'Power ok'***.

After a power outage, the battery will be recharged to its full capacity in three days at the earliest. Use only batteries supplied by Labkotec Oy.

4.4 Connecting temperature measurements

The device allows one temperature measurement to be connected to analogue input 4. An NTC thermistor is used as the temperature sensor. It is connected to terminals 28 and 30 as shown in the figure *Structure and connections* 2 . Jumper S300 must also simultaneously be set to '1–2'. Temperature can only be measured by using analogue input 4.

The measurement accuracy is +\- 1 °C within the temperature range -20 °C to +50 °C and +\- 2 °C within the temperature range -25 °C to +70 °C.

Use only temperature sensors supplied by Labkotec Oy.

Also see the section *Temperature measurement setup*: 8 .

4.5 Connecting the digital inputs

The Labcom 442 features four digital inputs of the current sinking type. The device provides them with a 24 VDC supply voltage, and the current is limited to around 200 mA. All the digital and analogue inputs have the same power supply and current limit.

The device can calculate the operating times and pulses of the digital inputs up to around 100 Hz.

4.6 Connecting the relay controls

The Labcom 442 features two relay outputs equipped with changeover contacts that can be used for various control applications (see the figure *Structure and connections* 2). The relays can be controlled via text messages or LabkoNet.

The Labcom 442 also features internal functions for making use of the relays.

The relay control options are presented in the section *Functions* 3 .

The relay details can be found in the section *Technical specifications* 23 .

4.7 Cabling

In order to maintain a sufficient level of protection against interference, we recommend using screened instrumentation cabling and, for the analog inputs, double-jacket cabling.

The device should be installed as far as possible from units containing relay controls, and other cabling. You should avoid routing input cabling closer than 20 cm from other cabling. Input and relay cabling must be kept separate from measurement and communications cabling.

We recommend using single-point earthing.

4.8 Installing the SIM card

The Labcom 442 works on the most common 2G, LTE, LTE-M and Nb-IoT subscriptions.

LabkoNet devices come with a pre-installed Micro-SIM card, which cannot be replaced.

If you want to use text messaging, you need to make sure that your subscription supports text messaging.

Insert the Micro-SIM (3FF) card you acquired for the Labcom 442 Communication Unit in your mobile phone and make sure that you are able to send and receive text messages.

Disable the PIN code query from the SIM card before installing it in the device.

Insert the SIM card into the holder as shown in figure 5 . Check the correct position of the SIM card in the guide picture printed on the circuit board and push the SIM card in this position to the bottom of the holder.

Figure 5: Installing the SIM card

4.9 Connecting an external antenna

By default, the device uses an internal antenna. However, it is also possible to connect an external antenna to the device. The type of antenna connector on the circuit board is MMCX female, so the external antenna connector must be of the type MMCX male.

Local installation requirements applicable to the installation location must be taken into account when installing an external antenna. The antenna and cable must be implemented as a separate installation, ensuring that there is no cabling or other sources of disruption in their immediate vicinity.

Figure 6 The antenna is connected to the MMCX connector above the radio module.

4.10 Operation of LED lights

The LED indicator lights of the device are marked on the circuit board with square frames. There is also identifying text next to them.

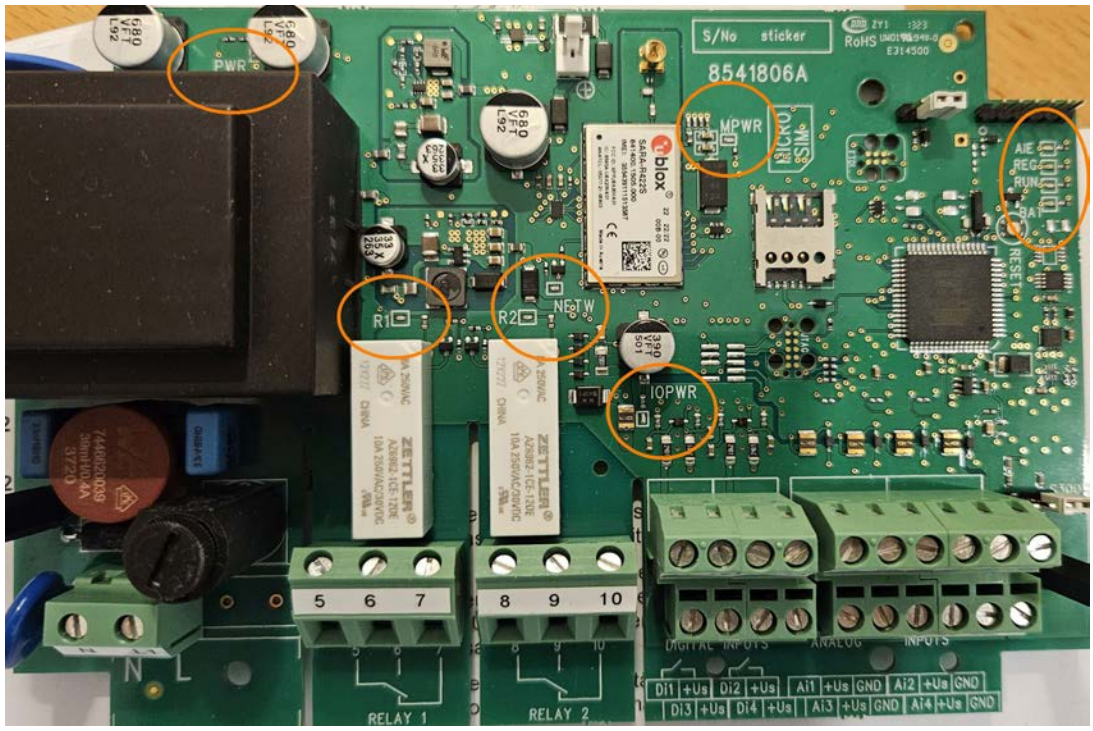


Figure 7 Locations of the LED lights on the circuit board

Identifier on PCB	Explanation of the LED identifier	Description of the LED light's operation
PWR	Power – green Voltage status in the 230 VAC version	The LED is on when the voltage is 230 VAC.
MPWR	Radio module power – green Radio module voltage status	On when the modem is energised.
AIE	Analogue input error – red Analogue input current error light	AIE blinks if the current exceeds 20.5 mA in any of the analogue inputs (A1–A4). At other times, AIE is not lit up.
REG	Registered in network – yellow Status of the modem's network registration	• Off – The modem is not registered in the network. • Blinking – The modem is registered, but the signal strength is less than 10 or the signal strength has yet to be confirmed. • Steady light – The modem is registered and the signal strength exceeds 10.
RUN	Data run – green Activity of the modem	• Blinks every second – normal state. • Blinks roughly every 0.5 seconds – the modem is transmitting or receiving data.
BAT	Battery status – yellow Status of the backup battery	• Blinking – the battery is charging. • Steady light – the battery is fully charged. • Off – no backup battery has been installed.
NETW	Network – yellow Operator network type	• LTE/NB-Iot home network – steady light. • 2G home network – blinks every two seconds. • LTE/NB-Iot roaming – blinks every second. • 2G roaming – blinks twice every two seconds.
IOPWR	Input-Output-Power – green Analogue output voltage status	On when the supply voltage to the inputs is on.
R1	Relay1 – yellow Relay 1 status light	On when relay 1 is on.
R2	Relay2 – yellow Relay 2 status light	On when relay 2 is on.

Table 1 Explanation of the LED lights

5 OPERATING PRINCIPLE

5.1 Operation

The Labcom 442 sends alarms and measurement data as text messages either directly to your mobile phone or to the LabkoNet® service.

You can use a secure data connection to set the times when measurement data is to be sent to the selected phone numbers. You can also query the measurement data with a text message.

In addition to the aforementioned transmission interval setting, the device will take readings from connected sensors at set intervals and send an alarm if a reading exceeds the set upper limit or falls below the set lower limit. A change in the status of the digital inputs also causes an alarm text message to be sent.

You can change the device settings and control the relays with text messages.

The parameters of the Labcom 442 control and data communication units connected to the LabkoNet system are managed via the LabkoNet system. If necessary, contact the LabkoNet customer service team at labkonet@labkotec.fi or by calling +358 29 006 6000.

5.2 Setup

You can setup the Labcom 442 fully via text messages. Setup a new device as follows:

1. Set the operator phone numbers
2. Set the end-user phone numbers
3. Set the device’s name and the parameters for the measurements and digital inputs
4. Set the alarm message texts
5. Set the time

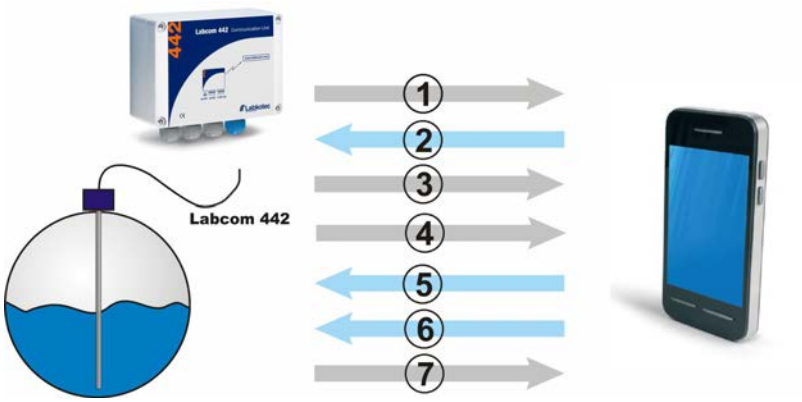
5.3 Labcom 442 and Mobile Phones

The figure below describes the messages sent between the user and the Labcom 442 communication unit. The messages are sent as text messages, described in more detail later in this document.

You can store two kinds of phone numbers on the device:

1. End-user phone numbers, to which measurement and alarm information is sent. These numbers can query for measurement results and control the relays.
2. Operator phone numbers, which can be used to modify the device settings. Neither measurement nor alarm information is sent to these numbers, but they can query for measurement results and control the relays.

NB! If you wish to receive measurement and alarm information to the same phone number from which you wish to modify device settings, you must set the number in question as both an end-user and an operator phone number.



1. Measurement result
2. Measurement query
3. Alarm message
4. Alarm deactivated message
5. Control message
6. Setup message
7. Acknowledgement message

Figure 8: Messages between a user and Labcom 442

5.4 Labcom 442 and LabkoNet®

Labcom 442 can be connected to the Internet-based LabkoNet® monitoring system. The LabkoNet® system's benefits when compared to a mobile phone connection include continuous monitoring of the connection and the storing and visual representation of measurement and alarm information.

Alarm and measurement information received from a measurement point is transmitted via the communication unit to the LabkoNet® service over the mobile phone network. The service receives the information sent by the communication unit and stores it in a database, from which it can later be read, e.g. for reporting purposes.

The service also checks the data from each measurement channel sent by the device, converts it to the desired format and checks for values not inside the set alarm limits. When alarm conditions are fulfilled, the service will send the alarms to predefined e-mail addresses as an e-mail and phone numbers as a text message.

The measurement data can be viewed over the Internet at www.labkonet.com using the end-user's personal user ID, both numerically and graphically with a regular Internet browser.

LabkoNet also has a wide range of application-specific logic that can be used with the Labcom 442 product.

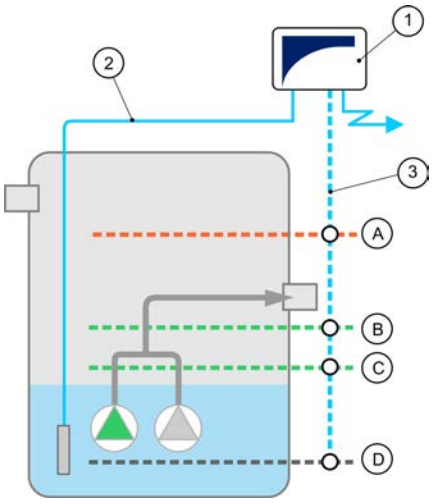
Figure 9: Diagram of the LabkoNet system

6 FUNCTIONS

In addition to its remote monitoring features, the Labcom 442 boasts functions that allow the device's relays to be controlled based on either measurement data or time. This section provides a general description of the device's functions.

6.1 Pumping station level adjustment and pump current measurement

The Labcom 442 can be used as a level adjustment device at a pumping station comprising one or two pumps. The device can be set up to either drain or fill a tank. If the level adjustment is implemented with one pump (relay), the remaining relay can be used for other functions.



1 Labcom 442

2 Measurement

3 Control

A Upper limit alarm

B Startup 2

C Startup 1

D Stop

Figure 10 . Pumping station application

When used at a pumping station, the Labcom 442 must be connected as follows:

AI1 = Level measurement, which controls the pumps
AI2 = Pump 1 operating current (optional)
AI3 = Pump 2 operating current (optional)
AI4 = Free

DI1 = Pump 1 run status (optional)
DI2 = Pump 2 run status (optional)
DI3 = Free (e.g. high level alarm switch)
DI4 = Free (e.g. common alarm)

DO1 = P1 control
DO2 = P2 control

Pump current measurements and run status feedback from the motor contactors are not mandatory data for pumping station operation. The run status allows the Labcom 442 to form the 'Pump will not start' alarms, as well as undercurrent and overcurrent alarms related to the measurement of the operating current, if desired.

The configuration and functions of the pumping station function are described in more detail in the section *Level monitoring at a small pumping station* 10 .

6.2 Relay timer functions

The Labcom 442's relays can be timer-controlled based on the on/off principle. The length of both the on period and off period can be configured for each relay. The length of the periods is given in seconds, and the maximum length of an on/off period is roughly 60 days.

For more information, see the section *Configuration of timer functions* 12 .

6.3 Relay control with analogue input level limits

The Labcom 442's relays can be controlled according to the levels of analogue inputs AI1 and AI2. The control is hard-wired to the inputs, with R1 being controlled by analogue input AI1 and relay 2 by input AI2. The relay is energised when the measurement signal is above the upper limit setting for the duration of the upper limit delay and de-energised when the measurement signal falls below the lower limit and remains there continuously for the duration of the lower limit delay.

For more information, see the section *Connecting the relay control to an analogue input* 13 .

7 COMMANDS AND DEVICE REPLIES

7.1 Phone Numbers

7.1.1 End user and operator phone numbers

The setup message for end user and operator phone numbers contains the following fields, separated by spaces:

Field	*Description*
`TEL` or `OPTEL`	TEL = Message code for an 'end user phone numbers' message (Numbers to which status, measurement data and error messages will be sent.) OPTEL = Message code for an 'operator phone numbers' message (Numbers from which messages containing configuration changes may be sent to the device.)
`<number>`	Phone number in an international format You can send all the numbers accepted by the device in one message (provided that they do not exceed the standard message length of 160 characters). You can set up to ten (10) end user mobile numbers. You can set up to five (5) operator phone numbers. The device saves the numbers in the first available memory slots in the order it receives them. If the message contains more than ten numbers or if no memory slots are available, the device will not save the excess phone numbers.

The sample message

```
TEL +35840111111 +35840222222 +35840333333
```

adds three end user phone numbers to the device. The device replies to this message as follows (one end user phone number has previously been saved in the memory):

```
<device name> TEL 1:+3584099999 2:+35840111111 3:+35840222222
4:+35840333333
```

In other words, the device's reply is in the following format:

```
<device name> TEL <memory slot number>:<phone number>
```

The message lists as many memory slot / phone number pairs as there are phone numbers stored in the memory.

You can query the end user phone numbers set for the device with the following command:

```
TEL
```

You can query the operator phone numbers set for the device with the following command:

```
OPTEL
```

7.1.2 Delete End-user and Operator Phone Numbers

You can delete phone numbers set on the device with end-user and operator phone number deletion messages. The message contains the following fields, separated by spaces.

Field	*Description*
`DELTEL or DELOPTEL`	DELTEL = Message code for an end-user phone number deletion message DELOPTEL = Message code for an operator phone number deletion message
`<memory_slot_number>`	The memory slot of a phone number stored on the device. You can find out the memory slots with TEL and OPTEL queries. If you enter more than one memory slot number, you must separate them by spaces.

The sample message

```
DELTEL 1 2
```

deletes the end-user phone numbers stored in the device's memory slots 1 and 2. The third end-user phone number stored in the memory remains in its old slot.

The device's reply to the previous message recounts the remaining numbers.

```
<device name> TEL 3:+3584099999
```

7.2 Basic Settings During Commissioning

7.2.1 Device or Site Name

You can use the device name message to set the device's name, displayed henceforth in the beginning of all messages. The message contains the following fields, separated by spaces.

Field	*Description*
`NAME`	Message code for a Device Name message.
`<device name>`	Device or site name. Maximum length 20 characters.

The sample message

```
NAME Labcom442
```

will be acknowledged by the device with the following message

```
Labcom442 NAME Labcom442
```

i.e. the device's reply is of the following format:

```
<device name> NAME <device name>
```

NB! The Device Name setting may also include spaces, e.g.

```
NAME Kangasala Labkotie1
```

You can query the name of the device with the following command:

```
NAME
```

7.2.2 Measurement message transmission interval and times

Use a ‘measurement message transmission interval and times' message to set the transmission interval and times when the device will send out measurement messages. The message contains the following fields, separated by spaces.

Field	*Description*
`TXD`	Message code for a ‘measurement message transmission interval and times’ message.
`<transmission interval>`	Measurement message transmission interval in days.
`<time>`	The measurement message transmission time format is hh:mm, where hh = hours mm = minutes. You can set a maximum of 24 daily transmission times for the device. These must be separated with spaces in the setup message.

The sample message

```
TXD 1 8:15 16:15
```

sets the device to send measurement messages daily at 8:15 am and 4:15 pm.

The device replies to this message as follows:

```
AlarmUnit TXD 1 8:15 16:15
```

In other words, the device's reply is in the following format:

```
<device name> TXD <transmission interval> <time>
```

You may query the device for the transmission interval with the following command:

```
TXD
```

7.2.3 Deleting the transmission times of measurement messages

This command can be used to clear the transmission times of measurement messages completely from memory.

Field	*Description*
`DELTXD`	Measurement message transmission deleting identifier.

The device’s reply to this message would be:

```
TXD 0
```

7.2.4 Time

You can set the time of the device's internal clock with a time setup message. The message contains the following fields, separated by spaces.

Kenttä	*Kuvaus*
CLOCK	Message code for a time setup message.
<date>	Enter the date in dd.mm.yyyy format ,where dd = day mm = month yyyy = year
<time>	Enter the time in hh:mm format, where hh = hours (NB: 24-hour clock) mm = minutes

The sample message

```
CLOCK 27.6.2023 8:00
```

would set the device's internal clock to 27.6.2023 8:00:00

The device will reply to the time setup message as follows:

```
<device name> 27.6.2023 8:00
```

You can query the device's time by sending the following command:

```
CLOCK
```

7.2.5 Automatic local time update from the operator network

The device will automatically update the time from the operator's network when it is connected to the network. The default time zone is UTC. If you want to update the time to the local time, you can activate this as follows:

Field	*Description*
AUTOTIME	Message code for a 'time setup' message.
<status>	0 = The time zone is UTC. 1 = The time zone is local time.

The sample message

```
AUTOTIME 1
```

sets the device to update to the local time. The device replies to the time setting as follows:

```
<header> AUTOTIME 1
```

The setting takes effect after the device or modem is restarted.

If the device is connected to LabkoNet, the AUTOTIME 0 setting may not be changed.

7.2.6 Signal Strength Query

You can query the signal strength of the modem with the following command:

```
CSQ
```

The device's reply is of the following format:

```
<laitenimi>  CSQ 25
```

Signal strength may vary between 0 and 31. If the value is below 11, the connection may not be sufficient for transmitting messages. Signal strength 99 means that signal strength has not yet been received from the modem.

7.3 Measurement Settings

7.3.1 Measurement setup

Use a 'measurement setup' message to set the names, scaling, units, alarm thresholds and alarm delays for measurements connected to the device's analogue inputs. The message contains the following fields, separated by spaces.

Field	Description
`AI<n>`	Message code for a 'measurement setup' message. The code indicates a physical measurement (analogue) input of the device. Accepted values: AI1, AI2, AI3 and AI4.
`<AI name>`	Free-form text set for a measurement. The name of the measurement is used as the measurement's identifier in measurement and alarm messages. See the section Measurement messages (there must be no space in the AI name), for example.
`<4mA>`	The measurement value provided by the device when the sensor current is 4 mA (scaling).
`<20mA>`	The measurement value provided by the device when the sensor current is 20 mA (scaling).
`<unit>`	The unit of measurement (after scaling).
`<lower limit>`	The value of the lower limit alarm (according to the scaling performed above). For details on how to set the lower limit alarm text, see section 20
`<upper limit>`	The value of the upper limit alarm (according to the scaling performed above). For details on how to set the upper limit alarm text, see section 20
`<delay>`	The alarm delay for the measurement in seconds. The alarm is triggered if the measurement remains above or below the alarm limit throughout the delay. The maximum delay is 34,464 seconds (~ 9 h 30 min).

The sample message

```
AI1 WellLevel 20 100 cm 30 80 60
```

sets up a measurement connected to analogue input 1 as follows:

- The name of the measurement is WellLevel (there must be no space in the name).
- The value 20 (cm) corresponds to the sensor value of 4 mA.
- The value 100 (cm) corresponds to the sensor value of 20 mA.
- The unit of measurement is cm.
- A lower limit alarm message is sent when the level of the well drops below 30 (cm).
- An upper limit alarm message is sent when the level of the well rises above 80 (cm).
- The alarm delay is 60 s.

7.3.2 Temperature measurement setup

You can connect an NTC type temperature sensor to analogue input 4.

Activate temperature measurement with the following command:

```
AI4MODE 2 0.8
```

Additionally, the jumper S300 next to channel 4 must be set to the correct position, i.e. 1–2.

The measurement scaling described in the previous section does not affect the temperature measurement settings apart from the unit of measurement and the alarm limits. Therefore, the AI4 command can be used to set e.g. C or degC as the unit and 0 °C and 30 °C as the alarm limits as follows (delay of 60 seconds):

```
AI4 Temperature 1 1 C 0 30 60
```

7.3.3 Measurement value filtering

A measurement value from a single point in time does not provide an accurate picture of the measurement in situations where the surface level is expected to fluctuate quickly. In such cases, you should filter the analogue measurement results. One example of a situation where sudden fluctuations occur is lake surface level measurement, in which waves cause the measurement results to vary by several centimetres within just a few seconds.

Field	Description
AI<n>MODE	Message code for a ‘measurement value filtering’ message, where <n> = 1–4. The code indicates a physical measurement (analogue) input of the device. Accepted values: AI1MODE, AI2MODE, AI3MODE and AI4MODE.
<mode>	Filtering mode. 0 = So-called digital RC filtering is enabled for the analogue channel, i.e. the measurement results are modified with the filtering factor <par>, which evens the difference between consecutive results.
<par>	The filtering factor. See below. If the mode is 0, <par> is the filtering factor between 0.01 and 1.0. The maximum filtering value is 0.01. No filtering is performed when <par> is 1.0.

You can define filtering separately for each analogue input.

To enable filtering for an analogue input, use the following command:

```
AI<n>MODE <mode> <par>
```

The sample command

```
AI1MODE 0 0.8
```

sets the value 0.8 as the filtering factor for analogue input 1, thus evening the difference between consecutive results.

You can query the filtering mode and value of each analogue input with the following command:

```
AI<n>MODE
```

where <n> is the number of the input in question.

The device's reply is in the following format:

```
<device name> AI<n>MODE <mode> <par>
```

Note! If no AI<n>MODE setting has been made for the channel, the default setting is *mode 0* (digital RC filter) with a factor of *0.8*.

7.3.4 Hysteresis Setting for Analog Inputs

If you desire, you can set a hysteresis error value for an analog input. The hysteresis error limit is the same for both the lower and upper limits. At the upper limit, alarm is deactivated when the input value has dropped at least the hysteresis value below the alarm limit. The operation at the lower limit is naturally the opposite. You can set the hysteresis error limit with the following message:

```
AI<n>HYST <hysteresis error limit>
```

where <n> is the number of the analog input.

Sample message

```
AI1HYST 0.1
```

The unit of measurement for the hysteresis error limit is the unit defined for the limit in question.

7.3.5 Setting the Number of Decimals

You can change the number of decimals in decimal numbers in measurement and alarm messages with the following command:

```
AI<n>DEC <number of decimals 0…9>
```

For example, you can set the number of decimals for analog input 1 to three with the following message:

```
AI1DEC 3
```

The device will acknowledge the setting with the following message:

```
<device name> AI1DEC 3
```

7.4 Digital Input Settings

7.4.1 Digital input setup

Use a 'digital input setup' message to set up the digital inputs of the device. The message contains the following fields, separated by spaces.

Field	Description
`DI<n>`	Message code for a ‘digital input setup’ message. The code indicates a physical digital input of the device. Accepted values: DI1, DI2, DI3 and DI4.
`<DI name>`	Free-form text set for a digital input. The name of the digital input is used as the digital input’s identifier in measurement and alarm messages. See e.g. the section Measurement setup 7 (there must be no space in the name), for example.
`<open>`	Text describing the open state of the digital input.
`<closed>`	Text describing the closed state of the digital input.
`<operating mode>`	The operating mode of the digital input. 0 = Alarm activated upon open status. 1 = Alarm activated upon closed status.
`<delay>`	The alarm delay in seconds. The maximum delay is 34,464 seconds (~ 9 h 30 min). NOTE! When the alarm delay of a digital input is set to 600 seconds or more and the alarm is activated, the delay for alarm deactivation is not the same as for activation. The alarm is deactivated 2 seconds after the input has returned to the inactive state. This makes it possible to implement a ‘Pump will not start’ alarm, for example.

The sample message

`DI1 DoorSwitch on off 0 20` (there must be no space in the name)

sets up the device's digital input 1 as follows:

- The device sends an alarm message 20 seconds after the door switch in digital input 1 is opened. The alarm message is in the following format:

  `<device name> <alarm text> DoorSwitch open`

- When the alarm is deactivated, the message sent is in the following format:

  `<device name> <alarm deactivated text> DoorSwitch closed`

7.4.2 Pulse Counting Settings

You can set up pulse counting for the device's digital inputs. Set the following parameters to enable counting:

Field	*Description*
PC<n>	Message code for a Pulse Counting message (PC1, PC2, PC3 or PC4).
<pulse counter text>	The pulse counter's name in the device's reply message.
<unit text>	The unit of measurement, for example 'times'.
<divisor>	You can set the counter to increase, for example, every 10th or 100th pulse. Set the desired integer between 1 and 65534 as the divisor.
<filtering delay>	The time the digital input must remain active before a pulse is registered in the counter. The unit of time used is ms, and the delay can be set between 1 and 254 ms.

Sample message for enabling pulse counting:

```
PC3 Pump3_on times 1 100
```

The device's reply to this message would be:

```
<device name> PC3 Pump3_on times 1 100
```

Sample measurement message from pulse counting:

```
<device name> Pump3_on 4005 times
```

You can clear the pulse counter with the following message:

```
PC<n>CLEAR
```

for example

```
PC3CLEAR
```

You can clear all pulse counters simultaneously with the following message:

```
PCALLCLEAR
```

7.4.3 Setting On-time Counters for Digital Inputs

You can set up a counter for digital inputs to count their on-time. The counter will increase every second the digital input is in the "closed" state. The message is of the following format:

Field	Description
OT<n>	On-time counter identifier, where <n> is the number of the digital input.
<on-time counter text>	The name of the counter in a measurement message.
<unit>	The unit of measurement in the reply message.
<divisor>	Divisor used to divide the number in the reply message.

A sample message in which the divisor of digital input 2 counter is set to one and ‘seconds’ as the unit, and the name of the counter is set to ‘Pump2’:

```
OT2 Pump2 seconds 1
```

Note that the unit is only a text field and cannot be used for unit conversion. The divisor is for this purpose.

You can disable the desired counter with the following message:

```
OT<n>CLEAR
```

You can disable all counters at once with the following message:

```
OTALLCLEAR
```

7.5 Relay Output Settings

7.5.1 Relay control

You can control the device relays with a ‘relay control’ message. The message contains the following fields, separated by spaces.

Field	Description
`R`	Message code for a ‘relay control’ message.
`R<n>`	Relay identifier. Accepted values: `R1` and `R2`.
`<status>`	Desired state of the relay: 0 = The relay output is de-energised, i.e. set to ‘off’. 1 = The relay output is energised, i.e. set to ‘on’. 2 = Impulse to the relay output.
`<impulse>`	Impulse length in seconds. This setting matters only if the previous setting is 2. However, this field must be included in the message even if no impulse is desired. In such cases, you should enter 0 (zero) as the field value.

The sample message

```
R R1 0 0 R2 2 20
```

sets up the device’s relay outputs as follows:

- Relay output 1 is set to the ‘off’ state.
- Relay output 2 is set to the ‘on’ state for 20 seconds before it returns to the ‘off’ state.

The device replies to the relay control message as follows:

```
<device name> R<n> <status> <impulse>
```

Note! The reply format differs from replies to other commands in this respect.

7.5.2 Level monitoring at a small pumping station

Level monitoring can be used to control two pumps at a small pumping station in either the tank drain or tank fill mode.

The input channels used in level measurement are defined fixedly as shown in the table below:

Input channel	Function in level monitoring
Analogue input AI1	Fluid level measurement 4–20 mA
Analogue input AI2	Pump P1 current 4–20 mA
Analogue input AI3	Pump P2 current 4–20 mA

The pumping station's operating parameters are set via LabkoNet or a text message, separated with spaces, as shown in the table below. With the exception of the operating mode, it does not matter in what order the parameters are given. The program automatically reserves an analogue input for level measurement and measurement inputs for motor currents if current measurement is configured with parameters. If you wish to monitor the pump run status with the help of relay feedback monitoring, you need to connect the run status from the motor contactors to digital inputs DI1 and DI2 and configure them separately. The other digital inputs may be used freely for things such as an upper limit alarm for the surface level and indication of the status of the motor guards. These functions must be configured separately. If the system only includes one pump, relay 2 may be freely used for another purpose.

Structure of a level monitoring setup message:

When used at a pumping station, the Labcom 442 can also measure the volume of water pumped based on the volumetric flow measurement principle. For water volume measurement, you will need the area of the well, which is entered as a separate parameter. In water volume measurement, the inflow during pumping is the average inflow calculated based on the change in the level measurement during the previous rest period. Water volume calculation is not in use in the FILL mode.

Field	Description	Field type	Factory setting
LEVEL	Command identifier	Text	
<opmode>	Operating mode	integer, 0 1, 2 or 3	3 (UNUSED)
NP <number of pumps>	Number of pumps	integer 1 or 2	2
LL <low level>	Surface level with input current of 4 mA	decimal 0–1,000 (cm)	4
P0 <pump stop level>	Surface level at which the pumps are stopped	decimal 0–1,000 (cm)	0
P1 <pump 1 start level>	Surface level at which pump 1 starts	decimal 0–1,000 (cm)	0
P2 <pump 2 start level>	Surface level at which pump 2 starts	decimal 0–1,000 (cm) ***)**	0
HL <high level>	Surface level with input current of 20 mA	decimal 0–1,000 (cm)	20
D0 <pump stop delay>	Delay in the pumps stopping	integer 0–30 s.	2
D1 <pump 1 start delay>	Delay in pump 1 starting up	integer 0–30 s.	2
D2 <pump 2 start delay>	Delay in pump 2 starting up	integer 0–30 s.	4
FB <pump run feedback>	The pump run status is connected to digital inputs 1 and 2. The digital inputs must be configured separately.	integer 1 or 2	1
CT <current transducers>	Pump current measurement in use	integer 0 = off, 1 = on	0
PA <pump alternation>	Pump alternation in use	integer 0 = off, 1 = on ***)**	1
WA <well area>	The area of the bottom of the well in square metres when measuring a pumping station's water volume	floating point number 0.0–32,000.0	0.0

***)** The parameter values only matter if two pumps are in use. In a one-pump system, there is no need to give parameters to the device.

The operating mode parameter has the following meanings:

Value	Function
0	Level measurement is in use but temporarily turned off. (OFF)
1	The operating mode is DRAIN. (DRAIN)
2	The operating mode is FILL. (FILL)
3	Level measurement is not used at all. (UNUSED)

Operating mode 0 assumes that the surface-level channels are in use / connected to the pumps, in which case e.g. control of the timer relays is prevented. The default settings include the number of pumps being set to two, pump alternation being enabled and the pump start/stop delays being set, among other things. Consequently, it may not be necessary to set anything besides the operating mode and level heights when the device is first put into service. After a power outage or device reset, the program prevents simultaneous startup of both pumps, even if the start delay is otherwise the same for both pumps.

If DRAIN is selected as the operating mode, the common values of the level height parameters
must meet the following condition:
LL < P0 < P1 < P2 < HL
Correspondingly, if FILL is selected as the operating mode, the following condition must be met:
LL < P2 < P1 < P0 < HL
If the conditions stated above are not met, the device will send an error code in accordance with table 2 .

Parameter settings

When level measurement is configured for the first time, the operating mode and surface-level values must be programmed. As the default parameter setting, the device assumes that two pumps are in use, the pumps are set to alternate and current measurement is off. Therefore, it may not be necessary to set these parameters in this case. Certain default values are also set for the pump start/stop delays.

An example of first setup, with two pumps, alternation enabled and DRAIN as the operating mode. The delays are according to the default settings. Lower level limit (4 mA) 0 cm, stop at 20 cm, 1st pump startup at 200 cm, 2nd pump startup at 250 cm, upper level limit (20 mA) 300 cm:

LEVEL 1 LL 0 P0 20 P1 200 P2 250 HL 300

DRAIN as the operating mode, one pump, lower level limit (4 mA) 0 cm, stop at 20 cm, pump startup at 250 cm with a 5 second delay, upper level limit (20 mA) 300 cm:

LEVEL 1 NP 1 LL 0 P0 20 P1 250 HL 300 D1 5

FILL as the operating mode, two pumps, no alternation, lower level limit (4 mA) 10 cm, stop at 270 cm, 1st pump startup at 100 cm, 2nd pump startup at 50 cm with a 2 second delay, upper level limit (20 mA) 300 cm:

LEVEL 2 LL 10 P0 270 P1 100 P2 50 HL 300 D2 2 PA 0

The device always replies to each accepted setting message by returning the values of each parameter for the sake of clarity. The operating mode is shown in text: MODE=DRAIN, FILL, OFF or UNUSED. The corresponding value is given in milliamperes after the level height settings P0–P2. In the event of an error in the setting parameters, the device will only return the error text ‘Error <error code>’. The error codes are presented in table 2 .

LEVEL PARAMS:
MODE=DRAIN
NP 2
LL 0
P0 20 (4.55)
P1 200 (14.48)
P2 250 (17.24)
HL 300
D0 2
D1 3
D2 4
CT 0
PA 1

After first-time configuration, you can set the device parameters by only giving the parameters you wish to change.

For example, if you wish to change the pump stop limit and the 2nd pump's start limit, you can give the following parameters:

LEVEL P0 30 P2 270

The device replies as follows:

LEVEL PARAMS:
MODE=DRAIN
NP 2
LL 0
P0 30 (5.10)
P1 250 (17.24)
P2 270 (18.34)
HL 300
D0 2
D1 5
D2 4
CT 0
PA 1

If you try to change the configuration presented above with an incorrect parameter value, such as

LEVEL P1 280

the device responds with the error code

Error -14 , and no parameter settings are changed.

You can turn off the pumping station with the following command:

LEVEL 0 , to which the device replies:

LEVEL PARAMS:
MODE=OFF
NP 2
LL 0
P0 30 (5.10)
P1 250 (17.24)
P2 270 (18.34)
HL 300
D0 2
D1 5
D2 4
CT 0
PA 1

In this case, the pumping station's parameters are saved in the memory, but pump control is turned off.
You can turn the device back on later with the following command:

LEVEL <mode> , with the mode being 1 or 2.

You can remove the pumping station application from use completely with the following command:

LEVEL 3 , to which the device replies:

LEVEL PARAMS:
MODE=UNUSED
NP 2
LL 0
P0 30 (5.10)
P1 250 (17.24)
P2 270 (18.34)
HL 300
D0 2
D1 5
D2 4
CT 0
PA 1

Following this, level measurement is no longer in use and does not control the relays at all. When you next reset the device, the other parameter values will also have been restored to the default settings.

Using current values to control the pumps

If you wish to control the pumps directly with current values instead of level height data, give the parameters directly in milliamperes. In this case, the values of parameters LL and HL must always be

LL 4
HL 20

and the pump start and stop limits must be within this range.

Settings query

You can query the settings with the setting message *LEVEL* without entering any parameters.

Status query

You can query the level monitoring status data with the message

LEVEL S

in which case the device will reply with the level height, pump run status and motor currents if current measurement is in use. The pump run status is based on the status of the pump's control relay, so it does not necessarily provide accurate data on the status of the motor contactors. The current provided is always the most recent operating current, even for a pump that has stopped.

MODE=DRAIN
LEVEL: 160.00 (12.03)
PUMP1: RELAY ON
I1: 14.5 mA
PUMP2: RELAY OFF
I2: 0.0 mA

Activation of level height alarm and measurement messages

If you wish to receive alarm and measurement text messages about changes in the level height, you need to configure channel AI1 in accordance with section 4.3.2 Measurement setup.
The program will change the LEVEL values P0, P1 and P2 to correspond to the current values (4–20 mA) of the measurement range and use filtered raw values to make the adjustment. If the levels are given as e.g. centimetres in the LEVEL commands, such as LL = 0 cm and HL = 200 cm, and
you would like to receive measurement messages in centimetres, with the lower alarm limit being 10 cm and the upper alarm limit being 190 cm, you must configure the AI1 channel as follows:

AI1 <'alarm text'> 0 200 cm 10 190 <delay>

Connecting pump run status and setting up an alarm about a run status conflict

You can monitor the run status of the pumps by using the relay control feedback monitoring alarm in accordance with section 4.3.14. In this case, the status of pump 1's contactor is connected to digital input DI1, while the status of pump 2's contactor is connected to input DI2. The device will then send an alarm if, while either pump is running, the status of the corresponding digital input is not '1' or, while the pump is stopped, the status is not '0'.

Error codes

The error codes sent by the device are presented in the table below.

Table 2 . Error codes

Error code	Explanation
-1	Incorrect operating mode
-2	Incorrect number of pumps
-3	Incorrect surface level with input current of 4 mA
-4	Incorrect pump stop level
-5	Incorrect start level of pump 1
-6	Incorrect start level of pump 2
-7	Incorrect surface level with input current of 20 mA
-8	Incorrect pump stop delay
-9	Incorrect start delay of pump 1
-10	Incorrect start delay of pump 2
-11	Incorrect pump current measurement setting
-12	Incorrect pump alternation setting
-13	Incorrect lower and upper limit level
-14	Drain mode with two pumps, condition P0 < P1 or P2 > P1 is not met
-15	Drain mode with two pumps, condition LL < P0 or P2 < HL is not met
-16	Drain mode with one pump, condition P0 < P1 is not met
-17	Drain mode with one pump, condition LL < P0 or P1 < HL is not met
-18	Fill mode with two pumps, condition P1 > P2 or P0 > P2 is not met
-19	Fill mode with two pumps, condition HL > P0 or P2 > LL is not met
-20	Fill mode with one pump, condition P0 > P1 is not met
-21	Fill mode with one pump, condition HL > P0 or P1 > LL is not met

7.5.3 Relay control feedback monitoring alarm

A relay conflict alarm can be used to monitor whether the circuits controlled by relays R1 and R2 are active. The control is based on the use of digital inputs, so that when the relay is active the status of the digital input controlling it must be '1', and when the relay is released it must be '0'. The control is connected to the digital inputs so that the control feedback for R1 is read from input DI1 and the feedback for relay R2 is read from input DI2.

Field	Description
`RFBACK`	Identifier of the relay feedback message
`<ch>`	Relay channel identifier The possible values are `1` (R1/DI1) or `2` (R2/DI2)
`<on_off>`	Conflict alarm selection 0 = Conflict alarm off 1 = Conflict alarm on
`<delay>`	Alarm delay in seconds. The alarm is activated if the status of the digital input controlling the relay is not '1' after a delay. The maximum delay can be 300 s.

Sample message:

```
RFBACK 1 1 10
```

switches on the monitoring of the relay output R1 of the device with an alarm delay of 10s.

The status of both relays can also be set at the same time:

```
RFBACK 1 1 10 2 1 15
```
, the order of the channels in the message is irrelevant.

The device always returns the setting values for both channels in the setup message:

```
RFBACK 1 1 10 2 1 15
```

The monitoring alarm can be disabled by setting the on/off mode to zero, e.g.

```
RFBACK 1 0 10
```

7.5.4 Configuration of timer functions

Both relays can be used as timer relays if the pumping station's level monitoring is not in use. However, if level monitoring is in use and there is only one pump, relay 2 may be used as a timer relay. If a timer relay is in use and the pumping station's level monitoring is later activated, the function is automatically blocked according to the number of pumps.

Field	Description	Field type ja arvoalue
RPWM	Command identifier	text
<channel>	Channel number	integer, 1 or 2
<Ton time>	Relay on time in seconds	integer 0-5200000
<Toff time>	Relay off time in seconds	integer 0-5200000

The maximum time for which a relay may be in the activated/deactivated state is around 60 days. The function is deactivated by setting the Ton time to 0. (Setting the Toff time to 0 also deactivates the function.)

The device replies to the setting message by restoring the default values in the same format used in the setting message. Both channels can be set with the same message or with separate messages. You can query the setting values
with a command without a parameter. The device always replies to both setting and query messages with the setting values of both channels for the sake of clarity.

Below are some relay setup examples:

1. The delay for relay 1 is set to 15/30 seconds.

```
RPWM 1 15 30
```

2. The delay is set to 10/30 seconds for relay 1 and to 10/10 for relay 2.
   The setting may be adjusted with a single message:

```
RPWM  1  10  30  2  10  10
```

3. The setting values are queried.

```
RPWM
```

   The device sends e.g. the following reply:

```
RPWM 1 10  30   2  10  10
```

4. Relay 2 is deactivated by setting the Ton time to 0.

```
RPWM 2  0
```

The deactivated relay can now be reactivated by giving the command

```
RPWM 2  10
```

in which case the device will set the Ton time to 10 and use the previous value as the Toff time.

7.5.5 Connecting the relay control to an analogue input

The relays can also be controlled according to the levels of analogue inputs AI1 and AI2. The control is hard-wired to the inputs, with R1 being controlled by analogue input AI1 and relay 2 by input AI2. The relay is energised when the measurement signal is above the upper limit setting for the duration of the upper limit delay and de-energised when the measurement signal falls below the lower limit and remains there continuously for the duration of the lower limit delay. The control requires that the channels are set to a scaled measurement range in accordance with the section Measurement setup 7 . The lower and upper limit measurement of the relay control follows the scaled range. Relay control is not active if the pumping station function is active and two pumps are in use. If there is only one pump, relay 2 may be used. The structure of the control command is presented below. The parameters must be separated by spaces.

Field	*Description*
RAI	Message code for a control message.
<ch>	Relay channel identifier. Accepted values: 1 (R1/AI1) or 2 (R2/AI2).
<lower limit>	The measurement signal level below which the relay is de-energised after the lower limit delay.
<lower limit delay>	The lower limit delay in seconds. The counter is 32-bit.
<upper limit>	The measurement signal level above which the relay is energised after the upper limit delay.
<upper limit delay>	The upper limit delay in seconds. The counter is 32-bit.

The sample message

```
RAI 1 100 4 200 3
```

sets relay 1 to be energised when the value of the measurement signal exceeds 200 for three seconds. The relay is de-energised when the signal falls below 100 and remains there for at least four seconds.

Similarly, relay 2 can be set with the message

```
RAI 2 100 4 200 3
```

Both relays can also be set with a single message:

```
RAI 1 100 4 200 3  2 100 4 200 3
```

This function can be disabled by setting the lower or upper limit of the channel to 0.

7.6 Modem configuration settings

The modem configuration settings below will only take effect after the modem has been reset. You do not have to reset after each command; it is sufficient to do it at the end of the configuration. The modem is reset automatically after the radio technology setting is adjusted, whereas for other commands it is sufficient to reset the modem at the end of the configuration. See the section *Restarting the modem*: 19

7.6.1 Choosing radio technology

The radio technologies used by the modem can be configured with a single message.

NOTE! If the radio technology or bands used are set to values not supported by your operator, the Labcom 442 Communication Unit cannot be configured through a text message connection.

Field	***Description***
RADIO	Command identifier
<technology>	RADIO 7 8 9 Sets LTE as the primary network, Nb-IoT as the secondary network and 2G as the last network. The unit responds: ***RADIO 7,8,9*** ***The setting is active after modem restart.*** You can read the current setting with a setting message that does not include parameters. ***RADIO*** If you wish to prevent the use of a certain technology, omit the numerical code corresponding to it from the command. With the sample command ***RADIO 7 9*** you can prevent the modem from connecting to the Nb-Iot network and allow the modem to connect only to the LTE/LTE-M or 2G network.

The following technologies are allowed:

- 7: LTE
- 8: Nb-IoT
- 9: 2G

RADIO 7 is selected by default, and the device only connects to the LTE network.

7.6.2 Operator profile selection

A message can be used to set the modem to a specific operator profile

Field	Description
MNOPROF	Message code for operator profile setup.
<profile number>	Profile number of the operator

The allowed profile choices are:

- 1: SIM ICCID/IMSI
- 19: Vodafone
- 31: Deutsche Telekom
- 46: Orange France
- 90: Global (tehdasasetus)
- 100: Standard Europe

Example setup message:

```
MNOPROF 100
```

The device's reply wuold be:

```
MNOPROF 100
Setting is active after modem restart.
```

The current setting is read with a message without parameters.

```
MNOPROF
```

7.6.3 LTE frequency bands of the modem

You can set the frequency bands of the modem's LTE network according to the operator's network.

Field	*Description*
BANDS LTE	Command identifier
<LTE frequency selection>	LTE frequency band numbers

The following bands are supported:

1 (2100 MHz)
2 (1900 MHz)
3 (1800 MHz)
4 (1700 MHz)
5 (850 MHz)
8 (900 MHz)
12 (700 MHz)
13 (750 MHz)
20 (800 MHz)
25 (1900 MHz)
26 (850 MHz)
28 (700 MHz)
66 (1700 MHz)
85 (700 MHz)

Enter the bands to be used in the command, with spaces.

```
BANDS LTE 1 2 3 4 5 8 12 13 20 25 26 28 66
```

The device replies to this setting message as follows:

```
LTE  1 2 3 4 5 8 12 13 20 25 26 28 66
The setting is active after modem restart.
```

NOTE! If the band settings include incorrect values, the program will ignore them and select only the supported frequencies from the message.

To read the current settings, send a setting message without parameters:

```
BANDS LTE
```

You can restore the LTE bands to the default settings with the following command:

```
BANDS LTE ALL
```

7.6.4 Nb-IoT frequency bands of the modem

You can set the frequency bands of the Nb-IoT network in the same way as the bands of the LTE network.

Field	*Description*
BANDS NB	Command identifier
<Nb-IoT frequency selection>	Nb-IoT frequency band numbers

The supported bands are the same as for the LTE network, and the setup is carried out similarly to the LTE network:

```
BANDS NB 1 2 3 4 5 8 20
```

The device replies as follows:

```
NB   1 2 3 4 5 8 20
The setting is active after modem restart.
```

To read the current settings, send a setting message without parameters:

```
BANDS NB
```

You can restore the NB-Iot bands to the default settings with the following command:

```
BANDS NB ALL
```

7.6.5 Reading the modem's basic radio settings

Field	Description
BANDS	Message code for modem's basic radio settings.

The message allows you to read the basic settings in one go, in response to which the selected radio technologies, operator name, current network, LTE and Nb-IoT bands used, operator profile and LAC and CI codes indicating the location of the modem at the cellular level are printed.

```
RADIO 7 8 9
OPERATOR "Telia FI" LTE
LTE 1 2 3 4 5 8 12 13 20 25 26 28 66
NB 1 2 3 4 5 8 20
MNOPROF 90
LAC  02F4 CI 02456
```

7.6.6 Name of the network operator and reading the type of radio network

Field	Description
OPERATOR	Message code for name of the network operator and the type of radio network.

The device responds with a message containing the network name used by the operator, the radio technology used

LTE/ NB/ 2G and the type of network HOME or ROAMING.

```
OPERATOR "Telia FI" LTE HOME
```

7.6.7 Restarting the modem

You must restart the modem after adjusting the settings related to frequency bands, radio technology, the operator profile and so on.

Field	*Description*
MODEMRST	Command identifier

The unit responds: **RESTARTING MODEM...**

7.7 Alarms

7.7.1 Alarm Texts

You can define alarm texts that the device includes at the beginning of the messages sent when an alarm is activated and deactivated with an alarm text setup message. Both cases have their own text. The message contains the following fields, separated by spaces.

Field	*Description*
ALTXT	Message code for an alarm text setup message.
<alarm on>.	Text sent when an alarm is activated, followed by a period.
<alarm off>	Text sent when an alarm is deactivated.

The alarm text (either <alarm on> or <alarm off>)>) is inserted in the alarm messages between the device name and the cause of the alarm. See more information in section Alarm Message 22.

Sample alarm text setup message:

```
ALTXT ALARM. ALARM DEACTIVATED
```

The device's reply to this message would be:

```
<device name> ALTXT ALARM. ALARM DEACTIVATED
```

The corresponding alarm message would then be:

```
Labcom442 ALARM <measurement name> ...
```

7.7.2 Measurement Upper and Lower Limit Alarm Texts

You can set up the text indicating the cause of an alarm and alarm deactivated messages with this command. For example, when a measurement value is lower than the lower limit alarm value, the device will send the corresponding lower limit alarm text in the alarm message. The message contains the following fields, separated by spaces.

Field	*Description*
`AIALTXT`	Message code for the measurement limit alarm text setup message.
`<lower limit txt>.`	The text sent when a lower limit alarm is activated or deactivated, followed by a period. The default value of this field is Low Limit.
`<upper limit txt>`	The text sent when an upper limit alarm is activated or deactivated. The default value of this field is `High Limit`.

The measurement upper and lower limit alarm texts are inserted in the alarm message after the name of the measurement or digital input that caused the alarm. See more information in section Alarm Message 22

Sample setup message:

```
AIALTXT Lower limit. Upper limit
```

The device's reply to this message would be:

```
<device name> AIALTXT Lower limit. Upper limit
```

The corresponding alarm message would then be:

```
Labcom442 ALARM Measurement1 Upper limit 80 cm
```

7.7.3 Alarm Message Recipients

You can define which messages are sent to whom with this command. As a default, all messages are sent to all users. The message contains the following fields, separated by spaces.

Field	*Description*
`ALMSG`	Message code for the alarm message recipient's message.
`<memory slot>`	The memory slot of a phone number stored on the device (you can check the slots with a TEL query).
`<messages>`	Which messages are sent, coded as follows: 1 = only alarms and measurements 2 = only deactivated alarms and measurements 3 = alarms, deactivated alarms and measurements 4 = only measurements, no alarm messages 8 = neither alarm messages nor measurements

The sample message

```
ALMSG 2 1
```

would set the messages sent to the end-user phone number stored in memory slot 2 as alarms and measurements.

The device's reply to the sample message would be as follows (containing the phone number stored in memory slot 2):

```
Labcom442 ALMSG +3584099999 1
```

i.e. the device's reply is of the following format:

```
<device name> ALMSG <phone number stored in memory slot>
<messages>
```

You can query the alarm recipient information for all end-user phone numbers with the following command:

```
ALMSG
```

7.8 Other Settings

7.8.1 Enable Channel

You can enable measurement channels with an enable channel message. Note, that measurement channels set up with a Measurement Setup or Digital Input Setup message are automatically enabled.

Including the message code, the message may include the following fields separated by spaces.

Field	*Description*
`USE`	Message code for an enable channel message.
`AI<n>`	The number of the analog channel to be enabled. One message may include all analog channels. The possible values are `AI1, AI2, AI3` and `AI4`
`DI<n>`	The number of the digital input to be enabled. One message may include all digital inputs. The possible values are `DI1, DI2, DI3` and `DI4`

The device will reply to the setup message and a query (just USE) by sending the new settings in the same format as the setup message, adding the device name to the beginning.

You can enable the device's measurement channels 1 and 2 and digital inputs 1 and 2 with the following sample message:

```
USE AI1 AI2 DI1 DI2
```

7.8.2 Disable Channel

You can disable measurement channels already defined and set up with a disable channel message. Including the message code, the message may include the following fields separated by spaces.

Field	*Description*
`DEL`	Message code for a disable channel message.
`AI<n>`	The number of the analog channel to be disabled. One message may include all analog channels. The possible values are `AI1, AI2, AI3` and `AI4`
`DI<n>`	The number of the digital input to be disabled. One message may include all digital inputs. The possible values are `DI1, DI2, DI3` and `DI4`

The device will reply to the setup message by sending the identifiers of all channels in use, adding the device name to the beginning.

You can disable the device's measurement channels 3 and 4 and digital inputs 1 and 2 with the following sample message:

```
DEL AI3 AI4 DI1 DI2
```

The device will reply with the enabled channels, for example

```
<device name> USE AI1 AI2 DI3 DI4
```

The device will also reply to just the DEL command by reporting the enabled channels.

7.8.3 Setting the voltage alarm for a backup battery or external battery

The device monitors the level of its operating voltage. The 12 VDC version directly monitors the operating voltage obtained from the battery, for example, while the 230 VAC device monitors the voltage of a possible backup battery. A low voltage alarm value sets the voltage level below which the device will send an alarm. The default value for this setting is 7.4 V.

The message contains the following fields, separated by spaces.

Field	*Description*
VLOWBAT	Message code for a 'low battery voltage' alarm message
<voltage>	The desired voltage in volts with one decimal. The integer and decimal are separated with a full stop.

The device's reply message is in the following format:

```
<device name> VLOWBAT <voltage>
```

For example, when you set the battery voltage alarm as follows:

```
VLOWBAT 8.0
```

the device will send an alarm if the voltage of the backup battery or external battery falls below 8.0 V.

The alarm message is in the following format:

```
<device name> Low battery 8.0V
```

You can query the low operating voltage alarm setting with the following command:

```
VLOWBAT
```

7.8.4 Operating voltage query

You can query the operating voltage of a battery-powered or mains-powered device with the following command:

```
VPSU
```

The device's reply to the query is in the following format:

```
<device name> VPSU <value> V
```

7.8.5 Backup battery voltage query

You can query the voltage of the backup battery of a mains-powered device with the following command:

```
VBAT
```

The device's reply to the query is in the following format:

```
<device name> VBAT <value> V
```

7.8.6 Querying the I/O bus voltage of field equipment

You can query the I/O bus voltage of field equipment with the following command:

```
VIO
```

The device's reply to the query is in the following format:

```
<device name> VIO <value> V
```

7.8.7 Software Version

You can query the software version of the device with the following command:

```
VER
```

The device’s reply to this message would be:

```
<device name> LC442 v<version> <date>
```

For example

```
Device1 LC442 v1.00 Jun 20 2023
```

7.8.8 Clearing Text Fields

You can clear text fields defined with messages by setting their value as the ‘?’ character. For example, you can clear a device name with the following message:

```
NAME ?
```

7.8.9 Restarting the Labcom 442

Field	*Description*
SYSTEMRST	Command identifier

8 MESSAGES SENT TO END-USERS BY THE DEVICE

This section describes the messages sent by the standard software version of the Labcom 442 communication unit. If other, customer-specific messages have been defined, they are described in separate documents.

8.1 Measurement Query

You can query the device for measurement values and states of the digital inputs with the following command:

```
M
```

The device's reply message will include the values of all enabled channels.

8.2 Measurement Result Message

Measurement Result Messages are sent to end-user phone numbers either timed, based on the *Transmission Interval* setting 5 or as a reply to a *Measurement Query* text message 21 .

The measurement result message contains the following fields separated by spaces. Only the information of channels enabled on the device is shown. A comma is used as a separator between all measurement results and digital input states (except the last one).

Field	*Description*	
<device name>	If a name has been defined for the device, it is inserted at the beginning of the message.	
<AIn txt> <value> <unit>,	The name of the measurement channel, the result, and the unit for each result. The data from different measurement channels are separated by commas.	
	<AIn name>	The name defined for measurement n.
	<value>	The result of measurement n.
	<unit>	The unit for measurement n.
<DIn name> <state>,	The name and state of each digital input. The data for different digital inputs are separated by commas.	
	<DIn name>	The name defined for a digital input.
	<state>	The state of the digital input.
<pulse counter name> <number of pulses> <unit>	If the pulse counter for a digital input has been enabled, its value is displayed in this field. The data for different counters are separated by commas.	
	<pulse counter name>	The name of the counter.
	<number of pulses>	The number of pulses divided by the divisor.
	<unit>	The unit of measurement.
<on-time counter name> <time> <unit>	If the on-time counter for a digital input has been enabled, its value is displayed in this field. The data for different counters are separated by commas.	
	<on-line counter name>	The name of the counter.
	<time>	The on-time of the digital input
	<unit>	The unit of measurement.

The sample message

```
Labcom442 Well level 20 cm, Weighing 10 kg, Door switch
closed, Door buzzer silent
```

indicates that a device named Labcom442 has measured the following:

- *Well_level* (e.g. Ai1) was measured as *20 cm*
- *Weighing* (e.g. Ai2) was measured as *10 kg*
- *Door_switch* (e.g. Di1) is in the *closed* state
- *Door_buzzer* (e.g. Di2) is in the *silent* state

Note! If no device name, measurement name and/or unit has been defined, nothing will be printed in their place in the measurement message.

8.2.1 Comma Settings in Measurement Messages

If you wish, you can remove commas from end user messages (mainly measurement messages) sent by the device. You can use the following messages to make these settings.

Commas not in use:

```
USECOMMA 0
```

Commas in use (normal setting):

```
USECOMMA 1
```

8.3 Alarm Message

Alarm messages are sent to end-user phone numbers but not to operator phone numbers.

An alarm message includes the following, separated by spaces.

Field	*Description*
<device name>	If a name has been defined for the device with the NAME command, it is inserted at the beginning of the message.
<alarm on>	The alarm text defined with the ALTXT command. e.g. HÄLYTYS.
<AIn name> or <DIn name>	The name of the measurement or digital input that caused the alarm.
<cause>	The cause of the alarm (lower or upper limit alarm) or the state text of the digital input.
<measurement value> and <unit>	If the alarm was caused by a measurement, the measurement value and unit will be included in the alarm message. This field is not included in alarm messages caused by a digital input.

Sample message 1:

```
ALARM Well level lower limit 10 cm
```

indicates the following:

- The well level has been measured to be below the lower limit.
- The measurement result was 10 cm.

Sample message 2 (Labcom442 defined as the device name):

```
Labcom442 ALARM Door switch open
```

indicates that the alarm was caused by the opening of the door switch.

Note! If no device name, alarm text, name for the alarm or digital input and/or unit has been defined, nothing will be printed in their place in the alarm message. It is therefore possible that the device will send a measurement alarm message containing only the measurement value, or a digital input alarm message containing nothing.

8.4 Alarm Deactivated Message

Alarm Deactivated messages are sent to end-user phone numbers but not to operator phone numbers.

An alarm deactivated message includes the following, separated by spaces.

Field	*Description*
<device name>	If a name has been defined for the device with the NAME command, it is inserted at the beginning of the message.
<alarm off>	The Alarm Deactivated text defined with the ALTXT command. e.g. ALARM DEACTIVATED.
<AIn name> tai <DIn name>	The name of the measurement or digital input that caused the alarm.
<cause>	The cause of the alarm (lower or upper limit alarm) or the state text of the digital input.
<measurement value>	If the alarm was caused by a measurement, the measurement value and unit will be included in the Alarm Deactivated message. This field is not included in alarm messages caused by a digital input.

The sample message:

```
ALARM DEACTIVATED Well level lower limit 30 cm
```

indicates the following:

- The lower limit alarm for the well level measurement has been deactivated.
- The measurement result is now 30 cm.

Sample message 2 (Alarm defined as the device name)

```
Alarm ALARM DEACTITATED Door switch closed
```

indicates that the door switch is now closed, i.e. the alarm caused by its opening has been deactivated.

8.5 Mains voltage disruption alarm

If mains voltage becomes unavailable, a 230 V device equipped with a backup battery sends an alarm message in the following format:

```
<device name> Power Failure xx.y. V
```

where xx.y is the voltage of the backup battery.

Once mains voltage is restored, the device sends out a recovery message in the following format:

```
<device name> Power ok xx.y V
```

9 SERVICE AND MAINTENANCE

Provided that proper care is taken and the device is disconnected from the mains supply, the distribution fuse (marked F4 160 mAT) may be replaced with an IEC 127 compliant, 5x20 mm / 160 mAT glass tube fuse.

9.1 Restoring factory settings

The device may be restored to the factory settings by connecting a jumper to the FRST connector and restarting the device. A restart will delete all of the device settings. Wait for the device to restart. Once all of the LED lights in the upper right corner of the circuit board start blinking, it means that the restoration of the factory settings is underway. The restoration is complete once the blinking stops and the LED lights stay on steadily. Next, turn off power from the device, remove the jumper and restart the device. The device is now ready to be configured in accordance with the manual.

9.2 Replacing a backup battery

Only use an official backup battery supplied by Labkotec. De-energise the device. Disconnect the old battery's cord from the circuit board connector. Remove the old battery from the device. Dispose of the battery according to local regulations. Secure the new battery to the device and check that it is securely in place. Connect the battery's conductors to the circuit board connector. Turn on the device. More information is available in the section Battery backup 1 .

9.3 Replacing the SIM card

De-energise the device. Remove the old SIM card from the circuit board. Remove the PIN code query from the new SIM card with the help of a phone, for example. Install the new SIM card into the device. Turn on the device. More information is available in the section*Installing the SIM card:* 2 .

9.4 Other problem situations

Problem:	**Action:**
Data transmission from the device is unreliable.	**1)** Check that the signal strength is sufficient, see the section *Signal strength query* 6. **2)** Check that the network operator and radio network are correct, see the section *Name of the network operator and reading the type of radio network* 18. **3)** If the operator is listed in the section *Operator profile selection*15 , make sure that the settings have been activated. **4)** Check that the subscription type and radio technology have been selected correctly, see the section *Choosing radio technology* 14 **5)** Find out from your operator which frequency band is the strongest in your area and force the device to operate in this band, see the section *LTE frequency bands of the modem* 16 or *Nb-IoT frequency bands of the modem* 17

Other service and maintenance tasks may only be carried out by a qualified electrician who is authorised by Labkotec Oy.

If problems occur, contact Labkotec Oy's service.

10 APPENDICES

10.1 Appendix: Technical specifications

Labcom 442 (230 VAC)	
Dimensions	175 mm x 125 mm x 75 mm (w x h x d)
Enclosure	IP 65, material: polycarbonate
Lead-throughs	5 pcs M16, cable diameter 5–10 mm
Operating environment	Operating temperature: -30 ºC to +50 ºC Max. elevation above sea level 2,000 m Relative humidity RH 100% Suitable for indoor and outdoor use (must be protected from direct rain)
Supply voltage	+/-10% 230 VAC, 50/60 Hz
Fuse	160 mAT, IEC 127 5x20 mm
Power consumption	Max. 18 VA
Analogue inputs	4 pcs, 4–20 mA active or passive, A1–A3 resolution 13 bit. Input A4, 10 bit. $U_{supplymax}$ = 28 VDC, max. 25 mA per input.
Digital inputs	4 pcs, $U_{supplymax}$ = 28 VDC, I_{inmax} = 10 mA
Relay outputs	2 pcs, SPDT, 250VAC/5A/500VA or 24VDC/5A/100VA
Data transfer	Built-in 2G, LTE, LTE-M, NB-IoT modem
Measurement and data transmission intervals	User defined
Electrical safety	EN 61010-1, Class II, CAT II/III, POLLUTION DEGREE 2
EMC	EN IEC 61000-6-3 (emissions) EN IEC 61000-6-2 (immunity)
RED	EN 301 511 EN 301 908-1 EN 301 908-2

10.2 EU DECLARATION OF CONFORMITY

Labkotec

EU DECLARATION OF CONFORMITY

We hereby declare that the product named below has been designed to comply with the relevant requirements of the referenced directives and standards.

Product Communication unit
Labcom 442

Manufacturer Labkotec Oy
Myllyhaantie 6
FI-33960 Pirkkala
Finland

Directives The product is in accordance with the following EU Directives:

2014/30/EU	Electromagnetic Compatibility Directive (EMC)
2014/53/EU	Radio Equipment Directive (RED)
2014/35/EU	Low Voltage Directive (LVD)
2011/65/EU	Restriction of Hazardous Substances Directive (RoHS)

Standards The following standards have been applied:

EMC:	EN 55032:2015+A1:2020, EN 55035:2017+A11:2020 EN IEC 61000-3-2:2019+A1 :2021, EN 61000-3-3:2013+A2 :2021 ETSI EN 301 489-1 V2.2.3 (2019-11) ETSI EN 301 489-52 V1.2.1 (2021-11)
RF:	ETSI EN 301 511 V12.5.1 (2017-03) ETSI EN 301908-1 V15.1.1 (2021-09) ETSI EN 301908-13 V13.2.1 (2022-02) EN IEC 62311:2020
LVD:	EN 61010-1:2010/A1:2019/AC:2019-04
RoHS:	EN IEC 63000:2018
Safety:	EN 62368-1:2018

Notified Body PHOENIX TESTLAB GmbH, Königswinkel 10 D-32825 Blomberg, Germany.
Notified Body number 0700.

The product is CE-marked since 2023.

Signature This declaration of conformity is issued under the sole responsibility of the manufacturer. Signed for and on behalf of Labkotec Oy.

Pirkkala 11.3.2024

Janne Uusinoka, CEO
Labkotec Oy

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