TANK RANGER

MODEL 5

Technical documentation

Prepared by: Wojciech Charzewski

Table of contents

Prepared by: Wojciech Charzewski

1.0 Introduction

1.1 Introduction

This documentation describes the installation procedure of the Tank Ranger model 5 central unit intended for continuous monitoring of the space between the mantles of tanks (e.g. of liquid fuels) or signalling tank overflows. It contains installation instructions for the central unit and the description of installation of the optical liquid sensor.

1.2 Warning

The procedures described in this documentation should be strictly followed during each system installation. For this reason, read any instructions very carefully before the installation.

1.3 Safety

Incorrect assembly of the system may result in danger for the installer and the users. That is why installation can be performed only by authorised personnel strictly complying with the recommendations for installation of devices in explosion hazard zones.

1.4 Control of operation

It is advisable to check the operation of the system at least once every 6 months, with particular focus on the sensors. This can be performed only by authorised personnel. Such checks should be recorded in the operation logbook of the device.

2.0 Description of the device

2.1 General information

Between 1 and 4 various types of sensors manufactured or provided by the Petroster company can be connected to the Tank Ranger model 5 central unit. These are the following sensors:

- petroleum derivative liquid fume sensor: PCO
- LPG sensor: PCG
- ethanol sensor: PCA
- carbon monoxide sensor: PCC.
- optical liquid sensor: PCOpt.
- optical liquid sensor: PCOpt/d.
- selective optical liquid sensor: PCOpt/s.
- separator sensor: PCSPr-2.
- double separator sensor: PCSPr-3.
- PCOes ester sensor.
- PCOam ammonia sensor.
- PCOsw hydrogen sulphide sensor.
- PCOet ethanol sensor.
- PCOtl toluene sensor.
- PCOtk toxic gas sensor.
- PCE air pollution sensor.

The alarm going off (activation of the sensor) causes the sound signaling (howler) to be switched on. This alarm can be cancelled with a button placed on the front panel of the central unit. The status of every sensor is additionally signalled by a red LED placed over the connector to which the sensor is connected. The LED is glowing when a given sensor is active. Optionally, the central unit can be equipped with an external lamp and a howler (12VDC) as well as an external alarm cancellation button.

The central unit may control other external devices using REL0 and REL1 relays (respective connectors TBR0 and TBR1).

Note: Relay REL0 is active when at least one sensor is active. Relay REL1 can be deactivated by pressing the alarm cancellation button!

2.2 Power supply

The device is powered by 230V AC 10W grid voltage.

2.3 Configuration

The sensor type is selected (connectors 1 to 4) by using a set of SWA switches (accordingly) 5 up to 8 on the motherboard of the central unit (8-position set of SWA switches). A switch in the ON position means that a connected sensor produces a high-status alarm. By analogy, if a switch is in the OFF position, then a connected sensor produces a low-status alarm.

SWA positions 1 through 4 allow the user to connect the sensor with an additional external supply resistor (for sensors 1 to 4 respectively). It is required for sensors with an Open Collector (OC) output.

The alarm thresholds can be adjusted using 4 potentiometers (RP0..RP3) on the motherboard (each potentiometer corresponds to a single sensor).

2 .4 View of central unit

Figure 1: Tank Ranger model 5 central unit.

Technical description of Tank Ranger model 5 central unit.

Height: Width: Depth:	180 mm 210 mm 83 mm
Power supply:	230V (50Hz) AC, 10 W
Range of operation temperatures:	-30 ºC..+ 50 ºC
Standard alarms:	4 visual (LEDs), 1 sound (internal howler).
Optional additional equipment:	1 external howler (12V) 1 external lamp (12V) 1 alarm cancellation button

2 .5 Central unit interior view

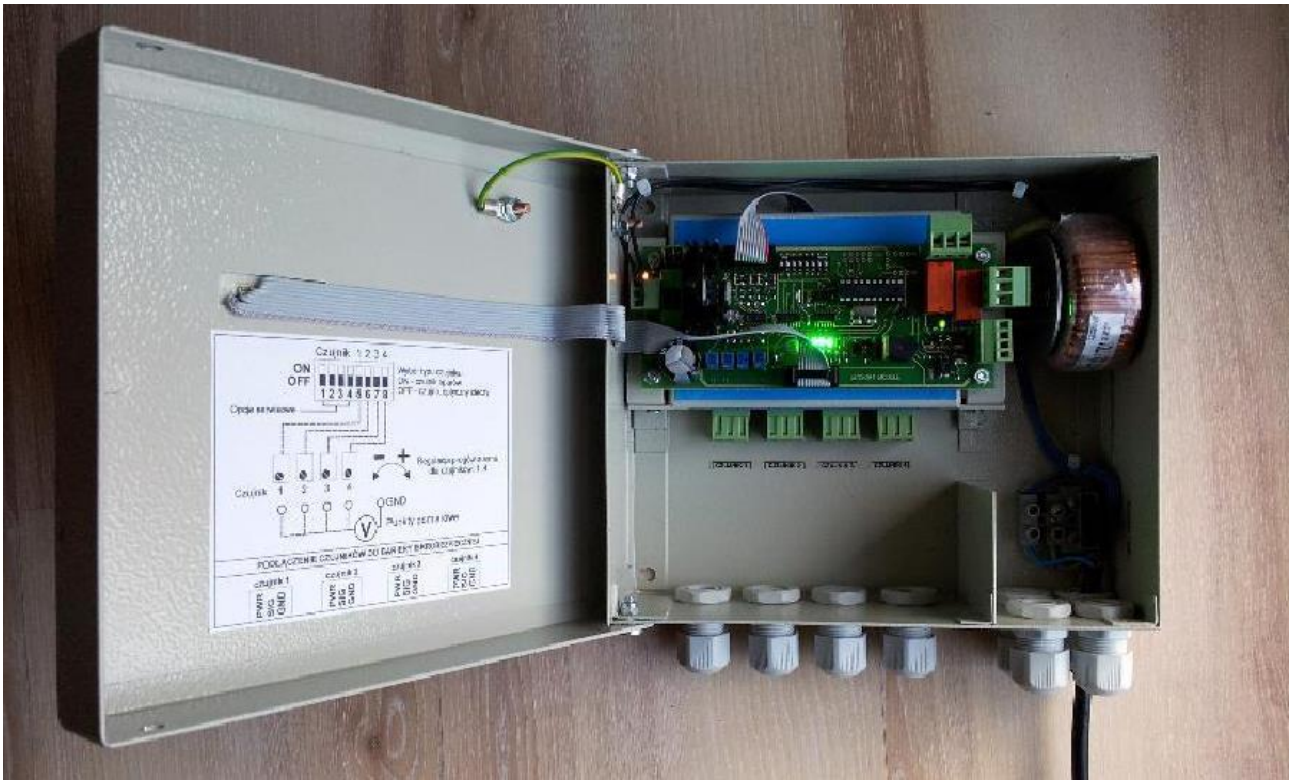

Figure 2: Tank Ranger model 5 central unit interior view.

2.6 Motherboard

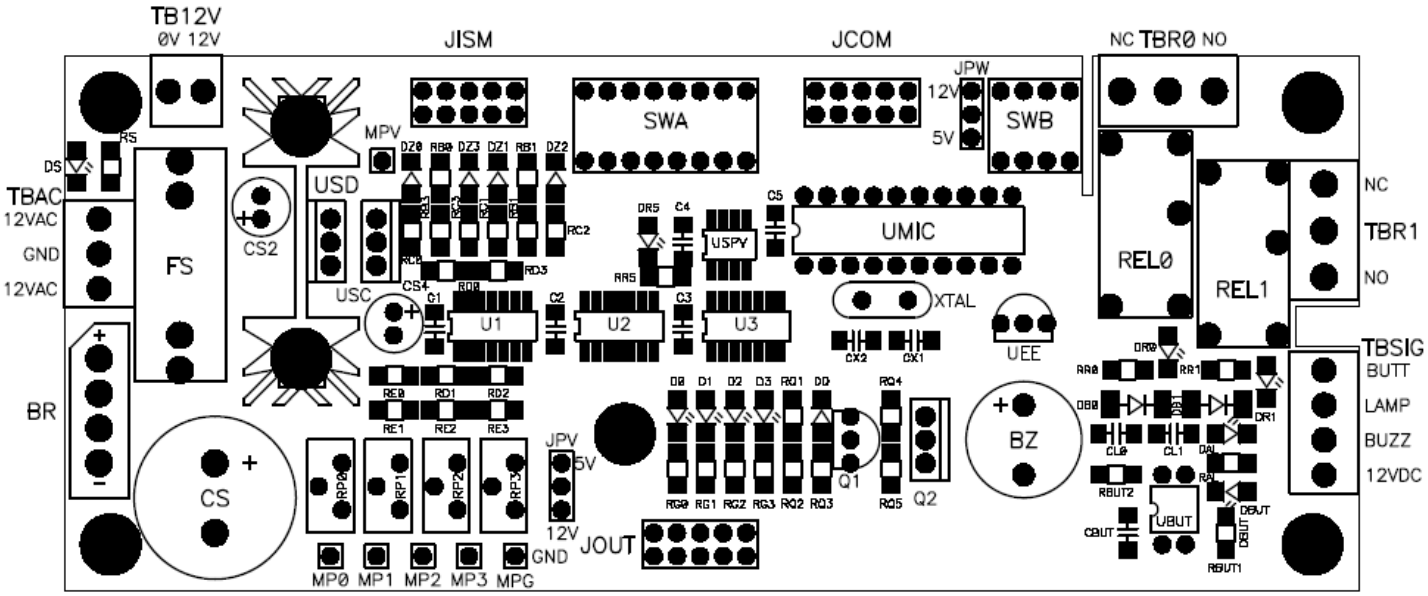

Figure 3: Motherboard of Tank Ranger model 5 central unit.

3.0 Spark safety

A ISM4 spark-safe barrier module has been installed in the central unit. The spark-safe barrier insulates the central unit from the explosion hazard zone where a liquid sensor can be installed. This insulation consists in limiting the energy emitted by the central unit to the connected device.

Technical description of spark-safe barrier module

Width: Height: Depth:	119 mm 25 mm wide 82 mm
Power supply:	18.7 DC, 6 W
Type EC examination certificate:	KDB 05ATEX204X
Anti-explosion protection symbol :	II (1) G [Ex ia GA] IIA -30 ºC ≤ Ta ≤ + 50 ºC
Range of operation temperatures:	-30 ºC..+ 50 ºC
Parameters of power supply outputs:	Uwy = 15.5 VDC, Iwy = 347 mA, Pwy = 1.28 W
Parameters of signal inputs:	Uwy = 5.93V DC, Iwy = 62 mA, Pwy = 91 mW

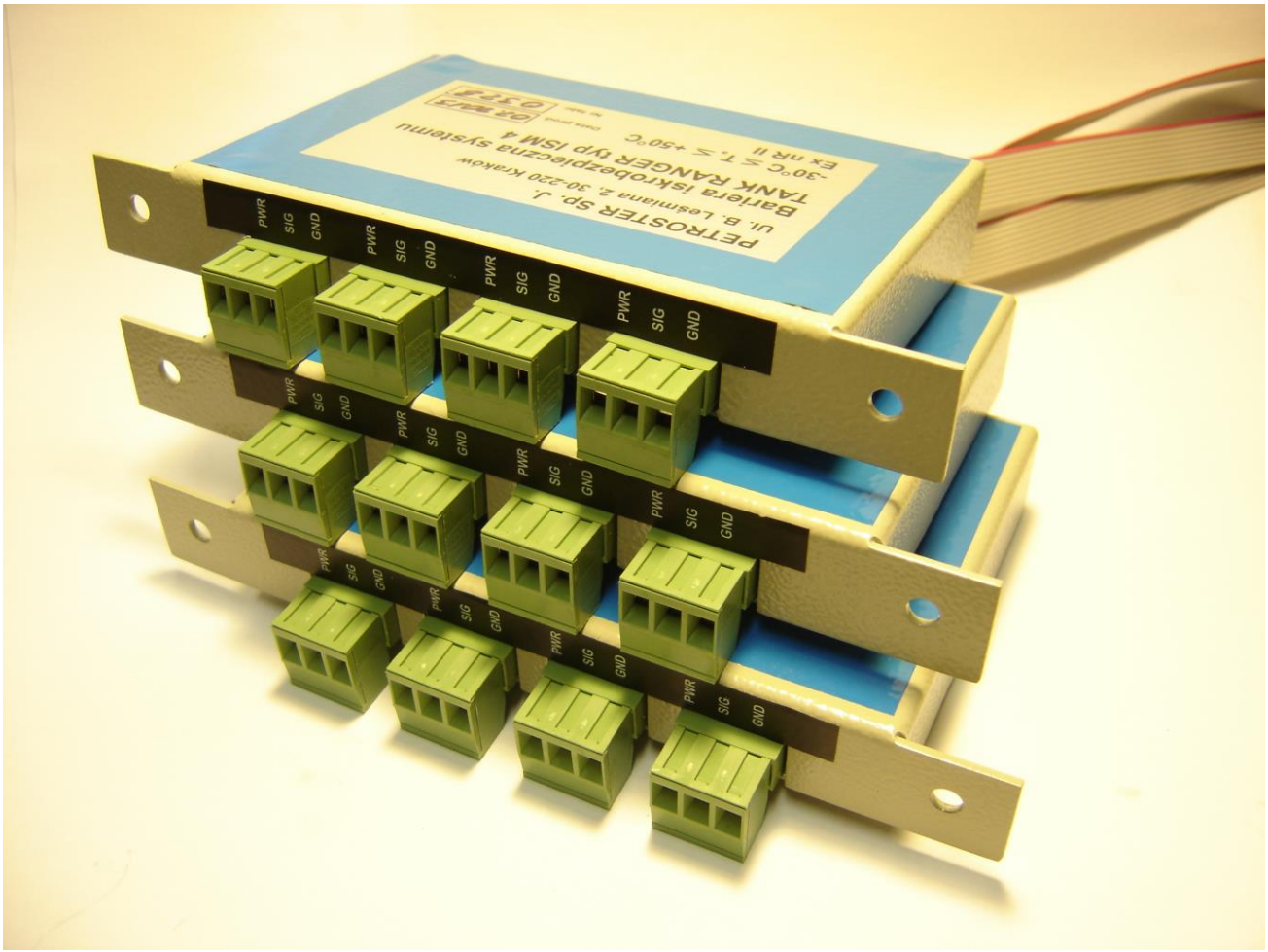

Figure 4: Spark-safe barrier module.

4.0 Sensors

4.1 PCO fume sensor

The fume sensor (Figure 5) can be placed in piezometers at one-mantle tanks, in the vicinity of pipelines or in the space between the mantles of two-mantle tanks. It can also be located on any dry base. When using this sensor take the following aspects into account:

- Proper installation and positioning of the sensor is of the utmost (critical!) importance.
- The sensor reacts only into certain fumes (petroleum derivatives). It will not operate in water steam or in the atmosphere of inert or oxygen-poor gases.
- The sensor will not indicate The presence of explosive or flammable fogs, lubricating oils or explosive dust (e.g. cereal or carbon).

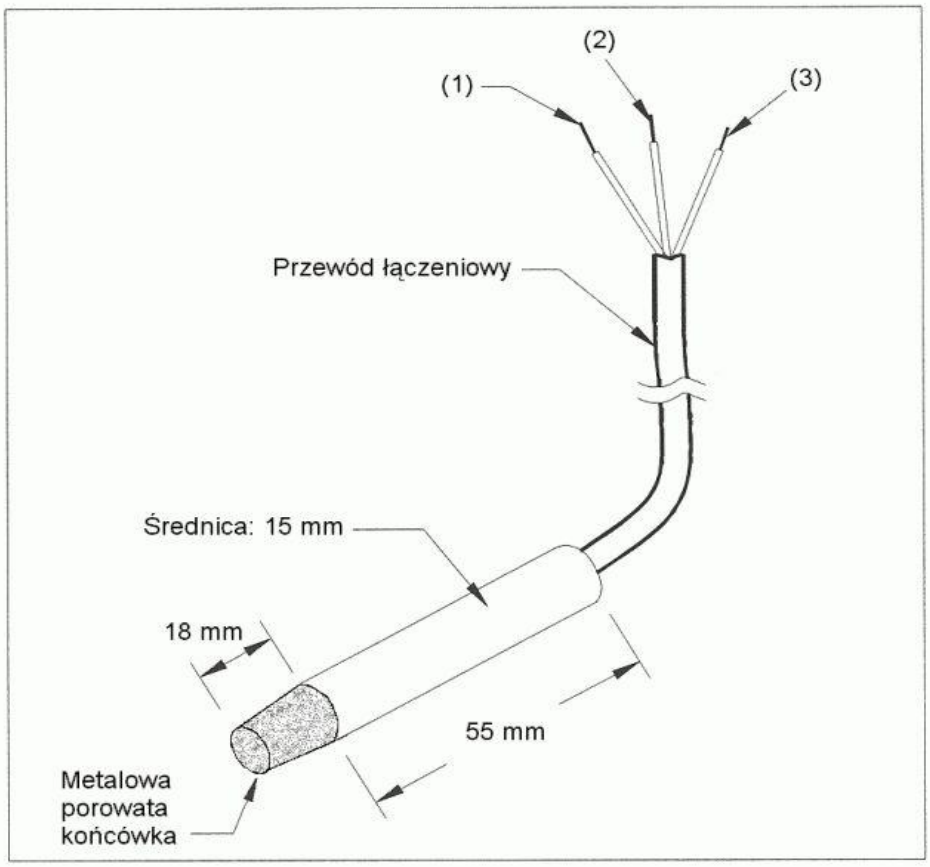

Figure 5: PCO fume sensor.

Technical description of PCO fume sensor

Length: Diameter:	73 mm 15 mm diameter batteries
Power supply:	12V DC, 60 mA
Ducts:	PWR-(1), SIG-(2), GND-(3)
Range of operation temperatures:	-30 ºC..+ 50 ºC
Detected substances:	Fumes of petroleum derivatives
Alarm	At high state

4.2 PCG LPG sensor

The LPG sensor (figure 6) is used for monitoring LPG installations. It can be placed next to gas pipelines or in the basins of LPG distributors. When using this sensor take the following aspects into account:

- Proper installation and positioning of the sensor is of the utmost (critical!) importance.
- The sensor reacts only to hydrocarbon gases.

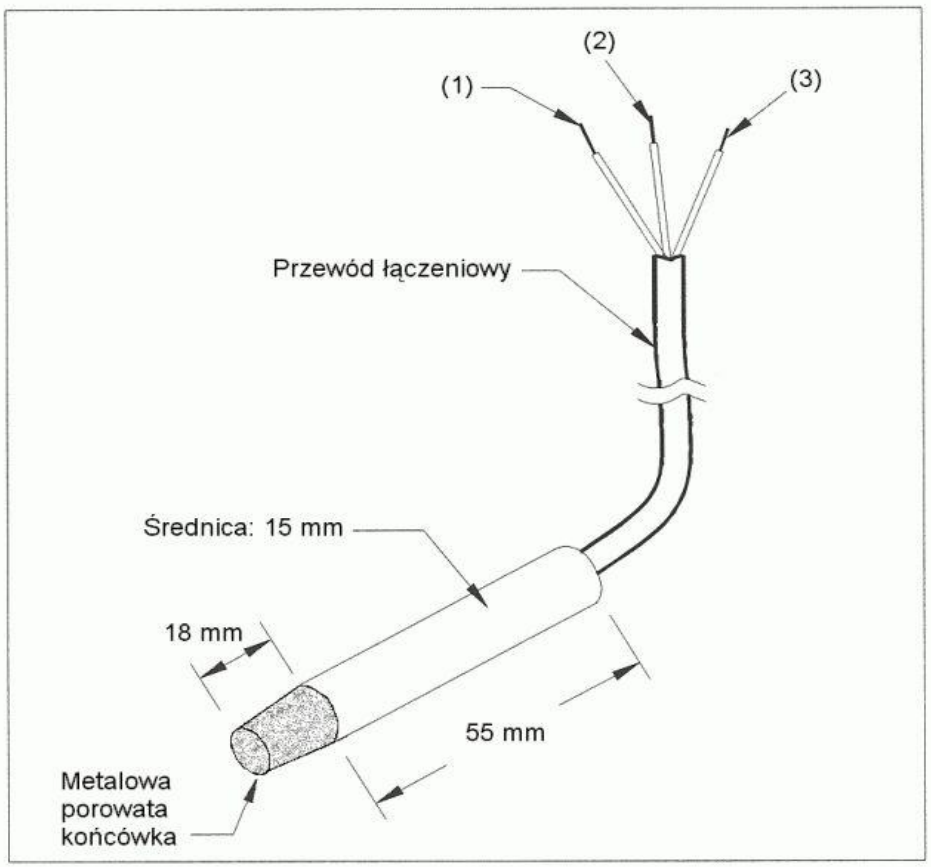

Figure 6: PCG LPG sensor.

Technical description of LPG PCG sensor

Length: Diameter:	73 mm 15 mm diameter batteries
Power supply:	12V DC, 60 mA
Ducts:	PWR-(1), SIG-(2), GND-(3)
Range of operation temperatures:	-30 ºC.. + 50 ºC
Detected substances:	Methane, propane, butane
Alarm	At high state

4.3 PCA alcohol sensor

The alcohol sensor (figure 7) is used for monitoring installations containing alcohol (for instance in food industry). It can be placed next to pipelines or inside the space between the mantles of tanks. When using this sensor take the following aspects into account:

- Proper installation and positioning of the sensor is of the utmost (critical!) importance.

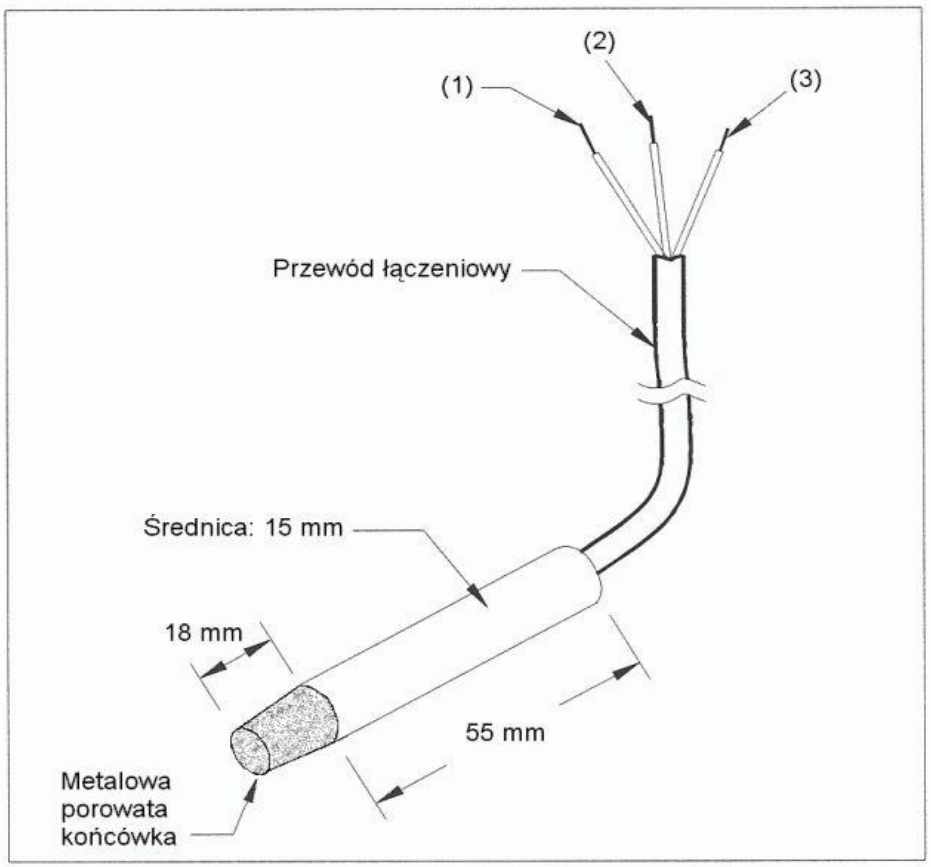

Figure 7: PCA alcohol sensor.

Technical description of LPG PCG sensor

Length: Diameter:	55 mm 15 mm diameter batteries
Power supply:	12V DC, 60 mA
Ducts:	PWR-(1), SIG-(2), GND-(3)
Range of operation temperatures:	-30 ºC..+ 50 ºC
Detected substances:	Ethanol fumes, fumes of organic solvents.
Alarm	At high state

4.4 PCC carbon monoxide sensor

The carbon monoxide sensor (figure 8) is used for monitoring rooms containing various kinds of furnaces or burners (e.g. boiler rooms). When the ventilation of such rooms is poor, carbon monoxide may appear in them. Carbon monoxide is a poisonous, odourless gas that can cause death.

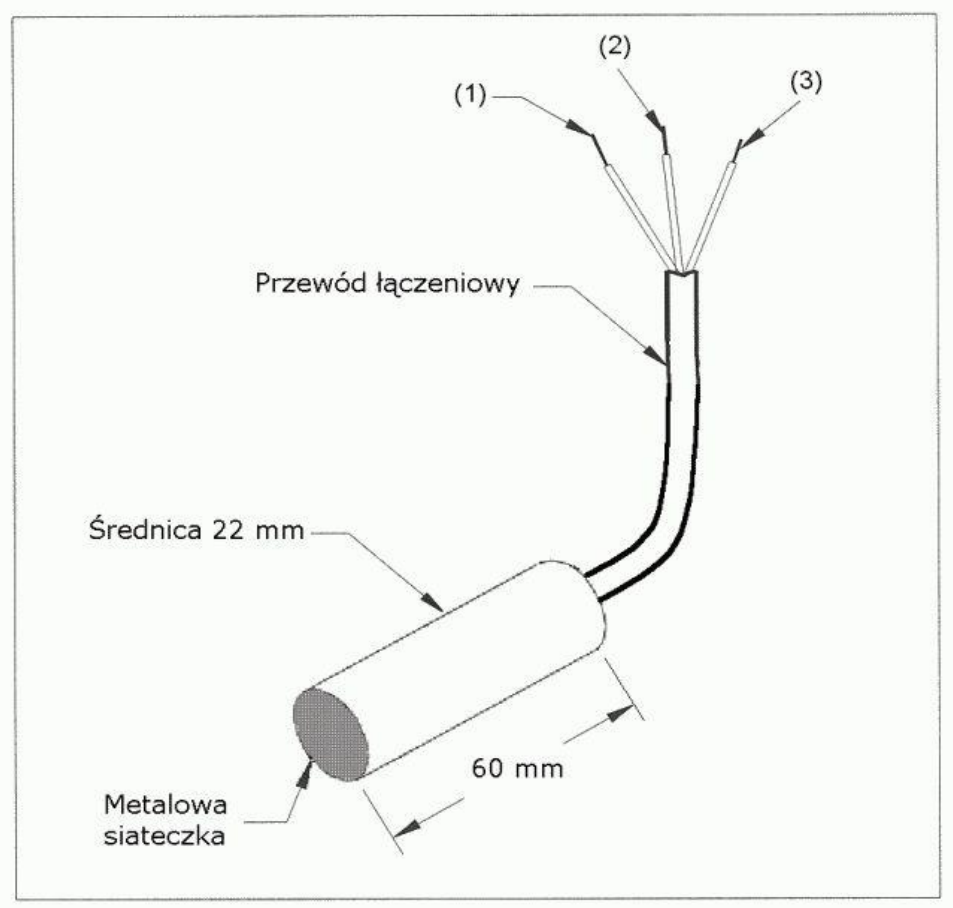

Figure 8: PCC carbon monoxide sensor.

Technical description of PCC carbon monoxide sensor

Length: Diameter:	60 mm 22 mm
Power supply:	12V DC, 80 mA
Ducts:	PWR-(1), SIG-(2), GND -(3)
Range of operation temperatures:	-30 ºC..+ 50 ºC
Detected substances:	Carbon monoxide
Alarm	At high state

4 .5 PCOpt optical liquid sensor

The PCOpt optical liquid sensor (figure 9) is used primarily for monitoring the space between the mantles of two-mantle tanks. It changes the output state after being submerged in a liquid. It can be placed in containers, distributors basins, hatches and other places where the emergence of a liquid may result in a leakage. Because of its small size it can be placed in hardly accessible places. The sensor does not differentiate hydrocarbon liquids from water.

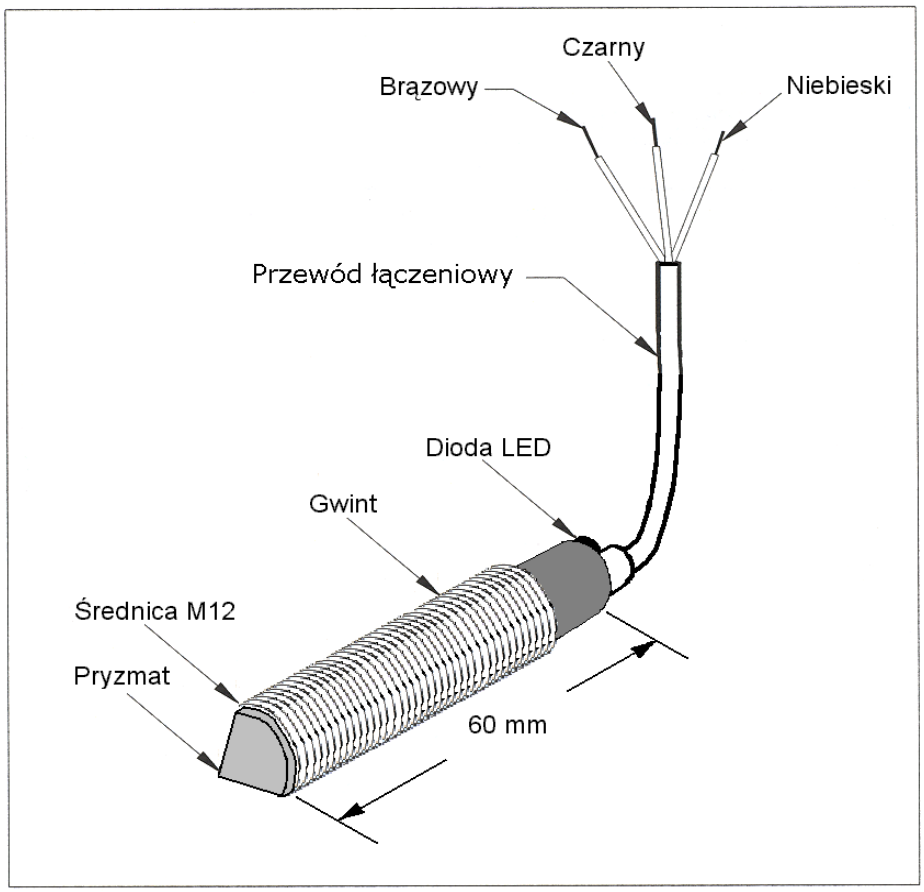

Figure 9: PCOpt optical liquid sensor.

Technical description of PCOpt optical liquid sensor

Length: Diameter:	66 mm 12 mm
Power supply:	12V DC, 40 mA
Ducts:	PWR-Brown, SIG-Black, GND-Blue
Range of operation temperatures:	-30 ºC – +50 ºC
Detected substances:	Liquids
Alarm	At low state

4 .6 PCOpt/d optical liquid sensor

The PCOpt/d optical liquid sensor (figure 10) is used primarily for monitoring the space between the mantles of two-mantle tanks. It changes the output state after being submerged in a liquid. It has been granted the ATEX spark safety certificate. It does not differentiate hydrocarbon liquids from water.

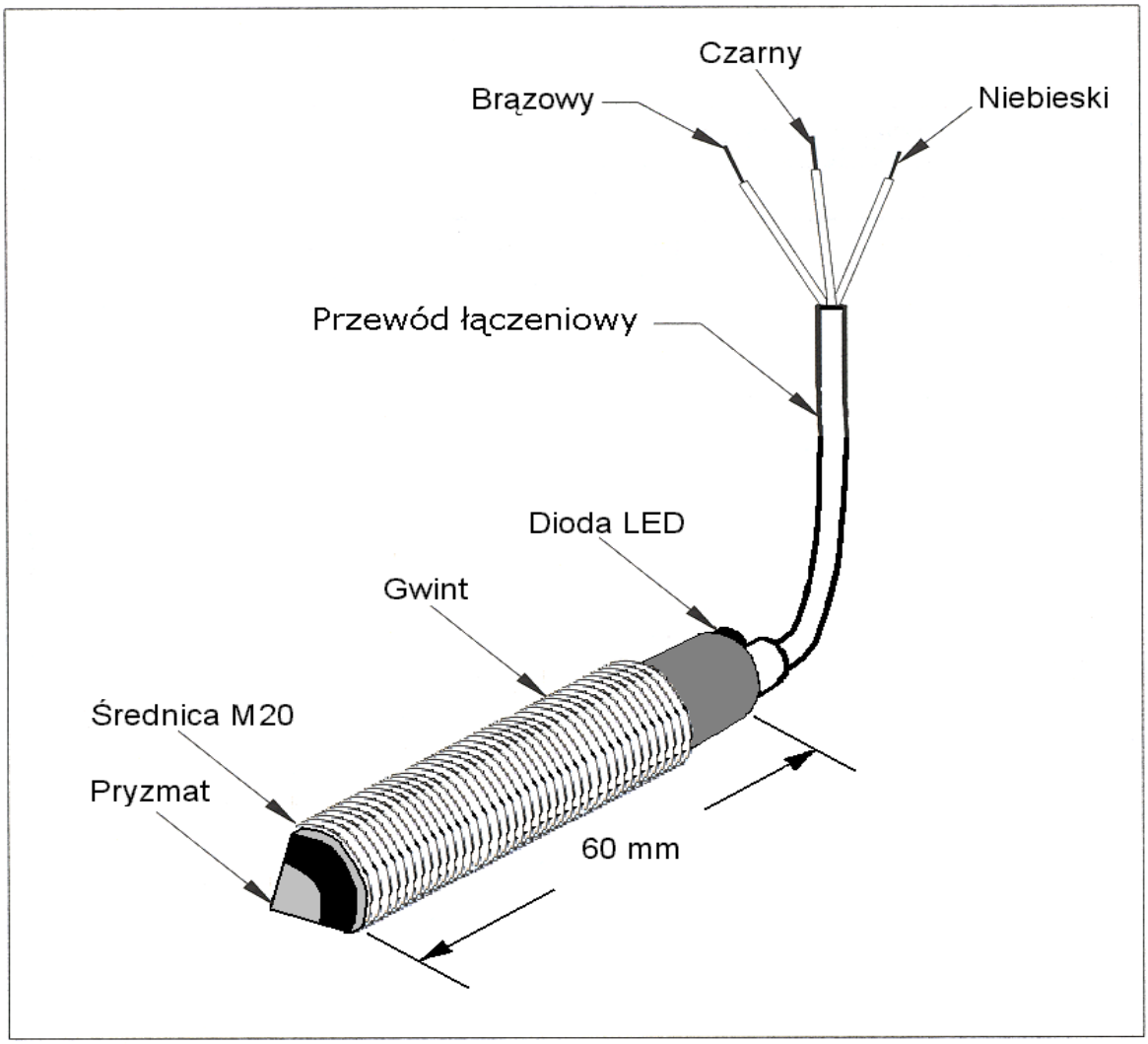

Figure 10: PCOpt/d optical liquid sensor.

Technical description of PCOp/optical liquid sensor d

Length: Diameter:	66 mm 12 mm
Power supply:	12V DC, 40 mA
Type EC examination certificate:	KDB 10ATEX053X
Anti-explosion protection symbol :	II 1G Ex ia IIA T4 Ga -30 ºC ≤ Ta ≤ + 50 ºC
Ducts:	PWR-(brown), SIG-(black), GND-(blue)
Range of operation temperatures:	-30 ºC – +50 ºC
Detected substances:	Liquids
Alarm	At low state

4.7 Selective PCOpt/s optical liquid sensor

The selective optical liquid sensor (figure 11) is used for monitoring fuel systems. It changes the SIG output state in the event of contact with water or other liquids. If water is detected, the SIG output voltage drops (**low alarm**). When the sensor is located in fuel, the SIG output voltage increases (**high alarm**).

Note: In the Tank Ranger model central unit 5 this sensor occupies two positions!

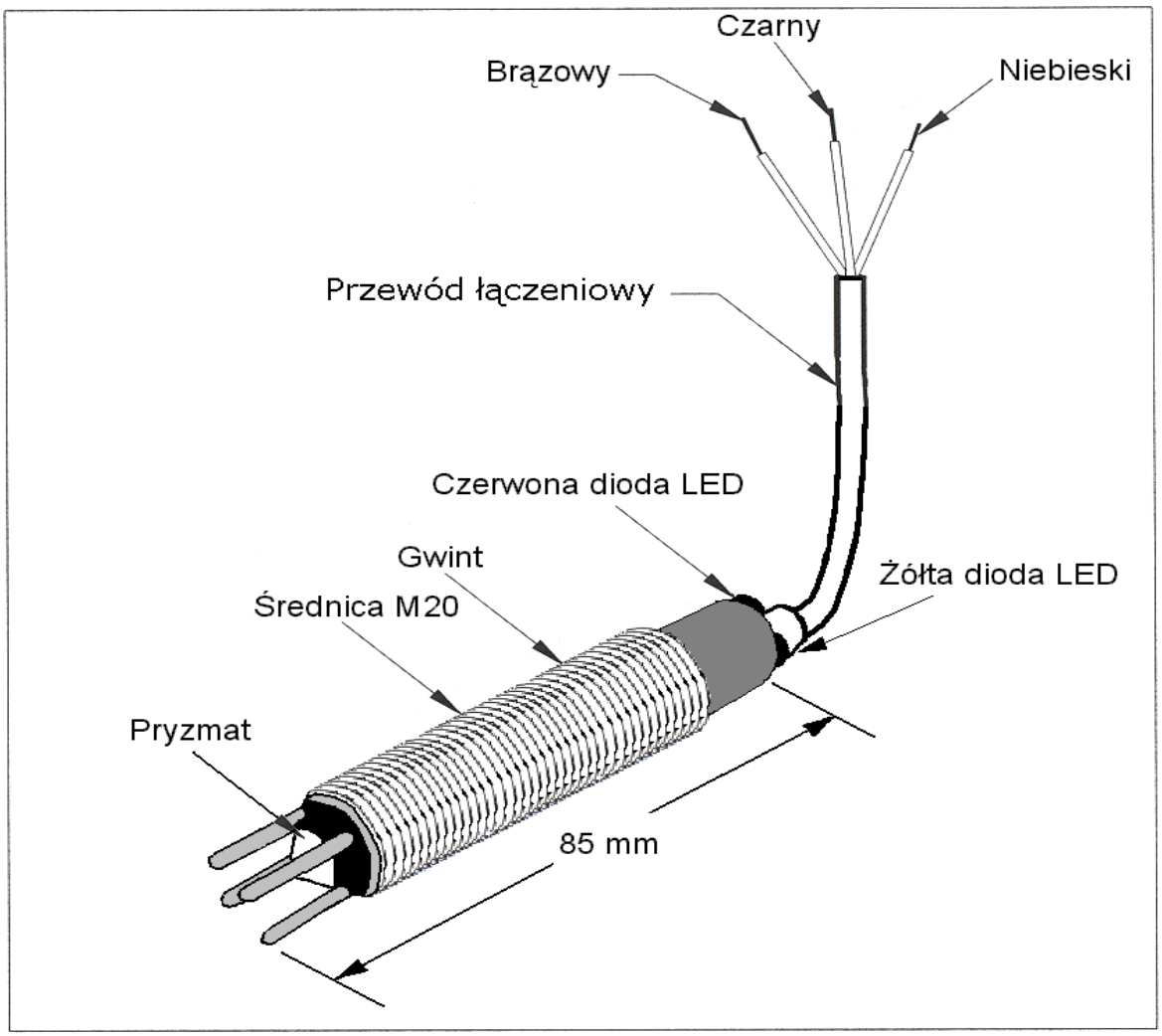

Figure 11: Selective PCOpt/s optical liquid sensor.

Technical description of selective PCOpt/s optical liquid sensor

Length: Diameter:	85 mm 22 mm
Power supply:	12V DC, 60 mA
Ducts:	PWR-(brown), SIG-(black), GND-(blue)
Range of operation temperatures:	-30 ºC..+ 50 ºC
Detected substances:	Liquids
Alarm	Water - low state Petroleum derivative liquids - high level

4.8 PCSPr-2 separator sensor

The separator sensor (figure 12) is used for detection of presence of petroleum derivative liquids in separators. The sensor signals an alarm in the case there is no water in the separator or petroleum derivative liquids appear in it. The length of the electrodes can be adjusted to the level of the liquid in the separator by shortening them. The thickness of the measured layer results from the difference in the length of the electrodes.

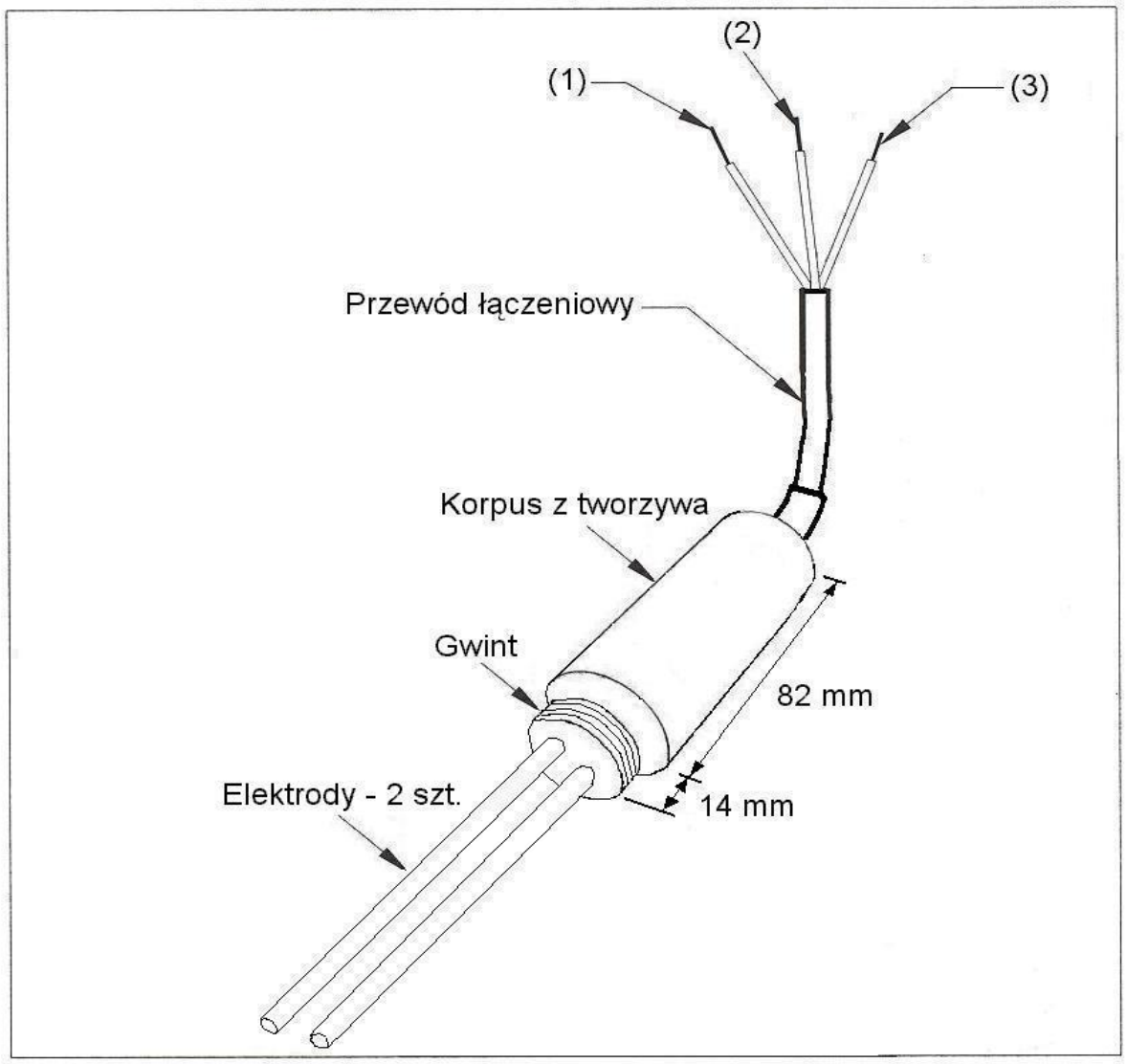

Figure 12: PCSPr-2 separator sensor.

Technical description of PCSPr-2 separator sensor

Length: Diameter:	128 mm 35 mm
Power supply:	12V DC, 20 mA
Range of operation temperatures:	-30 ºC – +50 ºC
Detected substances:	Petroleum derivative liquids in water
Ducts:	PWR-(1), SIG-(2), GND-(3)
Alarm	At high state

4.9 PCSPr-3 double separator sensor

The double separator sensor (figure 13) is used for detection of presence of petroleum derivative liquids in separators. The sensor signals an alarm in the case there is no water in the separator or petroleum derivative liquids appear in it. This sensor can operate in two different liquid levels. The length of the electrodes can be adjusted to the level of the liquid in the separator by shortening them. The thickness of the measured layer results from the difference in the length of the electrodes.

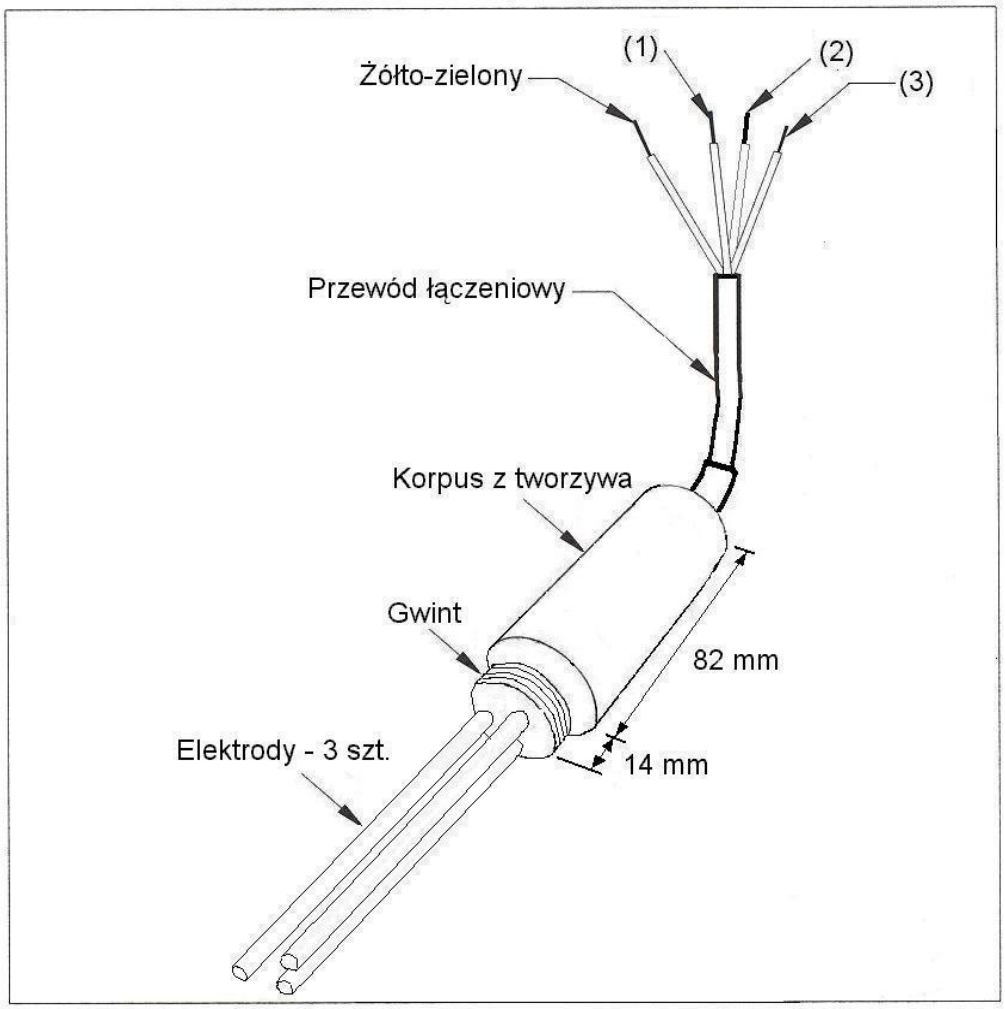

Figure 13: PCSPr-3 double separator sensor.

Technical description of PCSPr-3 double separator sensor

Length: Diameter:	180 mm 37 mm
Power supply:	12V DC, 40 mA
Range of operation temperatures:	-30 ºC – +50 ºC
Detected substances:	Petroleum derivative liquids in water
Ducts:	PWR-(1), SIG1-(2) (one measuring layer), SIG2-(3) (second measuring layer), GND-(Yellow-green).
Alarm	At high state

4.10 PCOes ester sensor

The ester sensor is used to detect fumes of various kinds of esters in the air.
The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

4.11 PCOam ammonia sensor

The ammonia sensor is used to detect ammonia in the air.
The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

4.12 PCOsw hydrogen sulphide sensor

The hydrogen sulphide sensor is used to detect hydrogen sulphide in the air.
The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

4.13 PCOet ethanol sensor

The ethanol sensor is used to detect ethanol fumes in the air.
The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

4.14 PCOtl toluene sensor

The toluene sensor is used to detect toluene fumes in the air.
The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

4.15 PCOgt toxic gas sensor

The toxic gas sensor is used to detect the presence of toxic gases in the air. The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

4.16 PCE air pollution sensor

The air pollution sensor is used to detect the presence of volatile air pollution. The visual appearance, the electrical parameters and the wire symbols are identical to the PCO fume sensor (see 4.1).

5.0 Installation of the controller

The central unit should be installed on a flat surface in a closed room outside the explosion hazard zone. For installation use the factory handles. Each wire passing through the hole is protected by a choke.

6.0 Installation of sensors

6.1 Two-mantle tank - dry monitoring

The space between the walls of a two-mantle tank is a perfect place for placing a fume sensor and an optical liquid sensor. An exemplary installation has been presented in figure 14.

If the external mantle of the tank is damaged and the space between the mantles is accessed by water from outside, then the optical liquid sensor will be activated. If the internal mantle is damaged, the product from the tank will get into the space between the mantles, which will result in activation of the optical sensor. Additionally, if fumes appear (e.g. petrol fumes), the fume sensor will be activated.

Installation procedure

1. *Leading the wire (in proper oil-proof insulation) to the Tank Ranger central unit.*
2. *Identification of the depth at which the sensors are placed; shortening the connection wires.*
3. *Connecting the sensor wires with the main wire in the Ex connection box.*
4. *Connecting the wire to the connectors in the central unit*
5. *Placing the sensors in the space between the mantles of the tank (the optical sensor should be placed at the bottom of the tank!).*

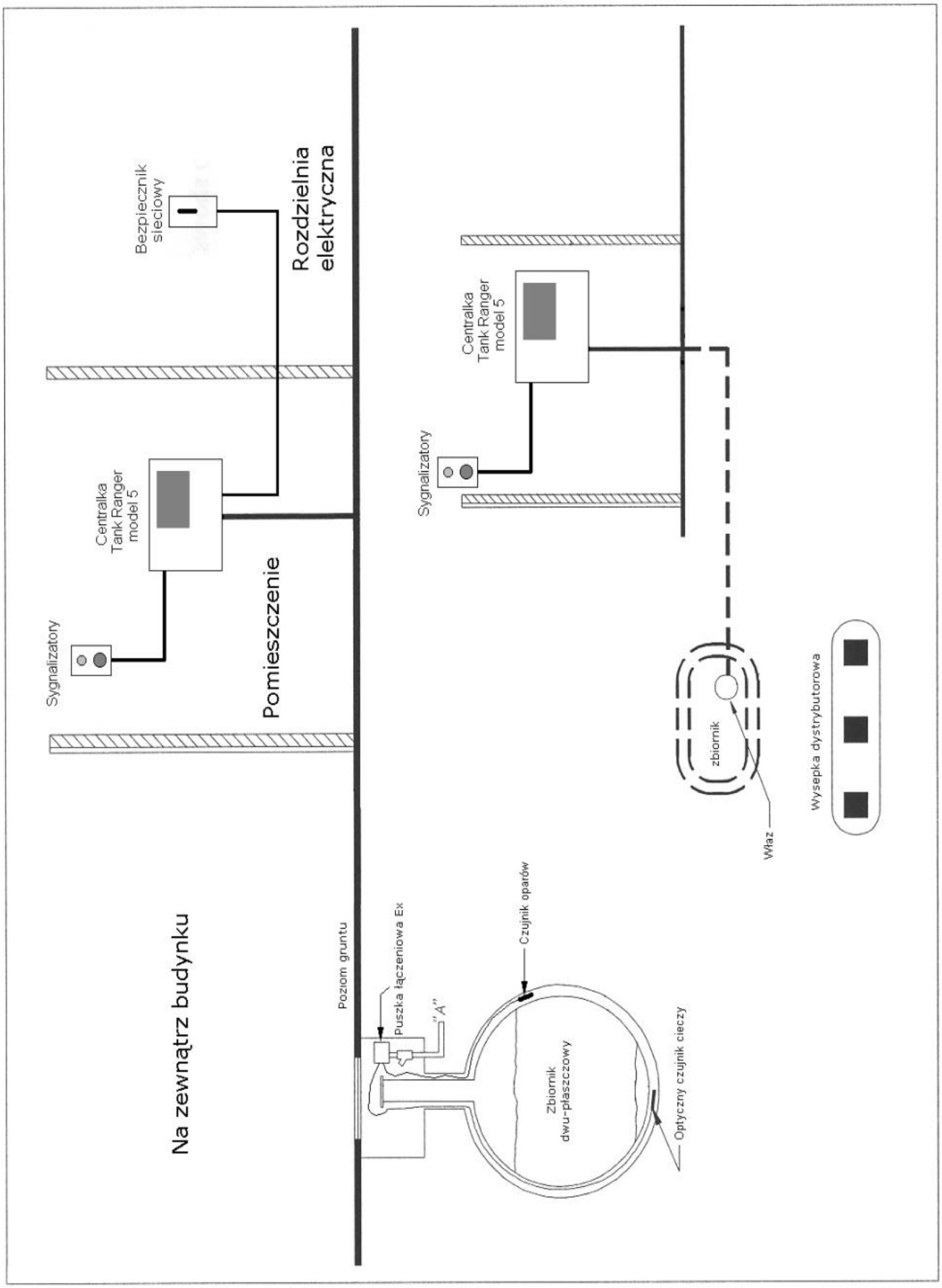

Figure 14: Installation of sensors in the tank mantle.

6.2 Compensatory tank

The compensatory tank with an optical liquid sensor is used to monitor the tanks with hydrostatic detection. The optical liquid sensor reacts to any changes in the level of the liquid filling the space between the mantles. An example of the installation is shown in figure 15.

Installation procedure

1. *Leading the wire (in proper oil-proof insulation) to the Tank Ranger central unit.*
2. *Placing the sensor in the compensatory tank at a proper height.*
3. *Connecting the sensor wire with the main wire in the Ex connection box.*
4. *Connecting the wire to the central unit.*
5. *Refilling the liquid in the tank so that the level of the liquid in the tank in a steady state is located at a proper height.*

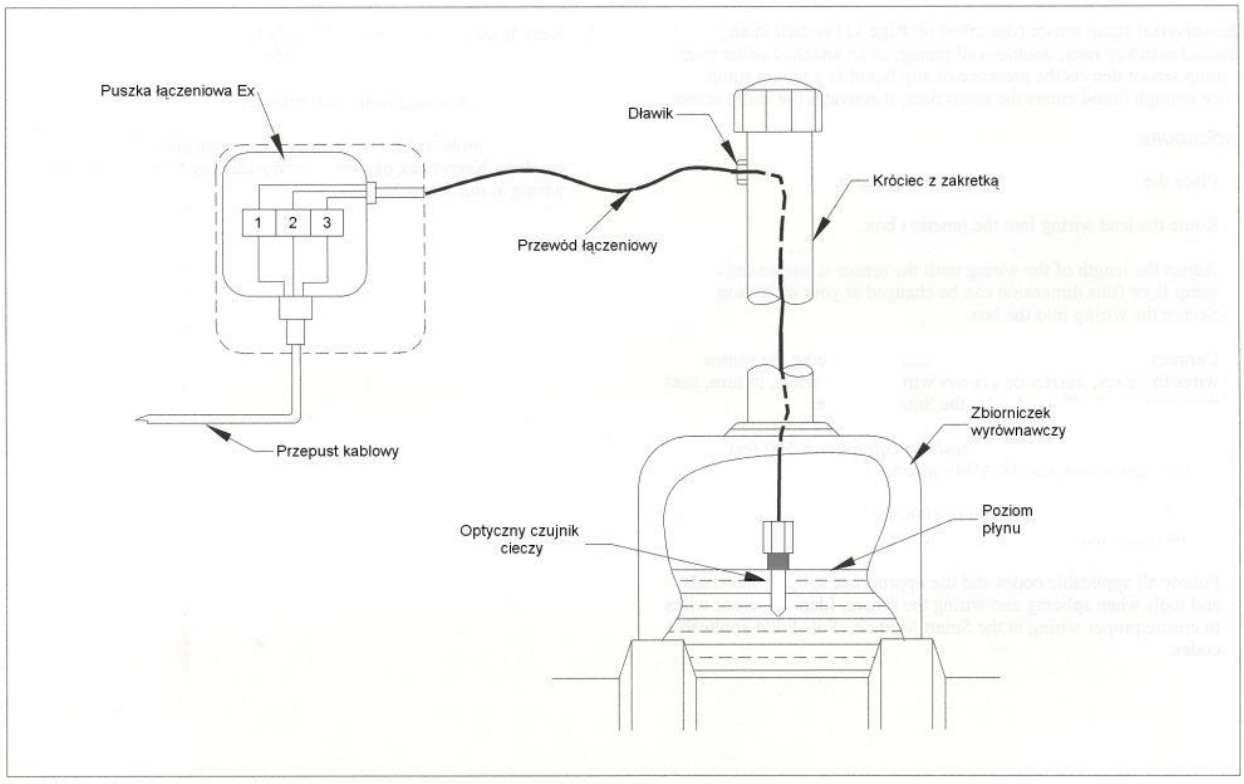

Figure 15: Installation of the sensor in the compensatory tank.

6.2 Separator

At a fuel station the separator is used for purging the rain water (ground water) drained from the tank field. It is supposed to separate both mechanical contamination (sand, stones) as well as petroleum derivative liquids from the water. The separator sensor reacts to any presence of petroleum derivative liquids in the water. An example of the installation is shown in figure 16.

Installation procedure

6. *Leading the wire (in proper oil-proof insulation) to the Tank Ranger central unit.*
7. *Placing the sensor at a proper height.*
8. *Connecting the sensor wire with the main wire in the Ex connection box.*
9. *Connecting the wire to the central unit.*

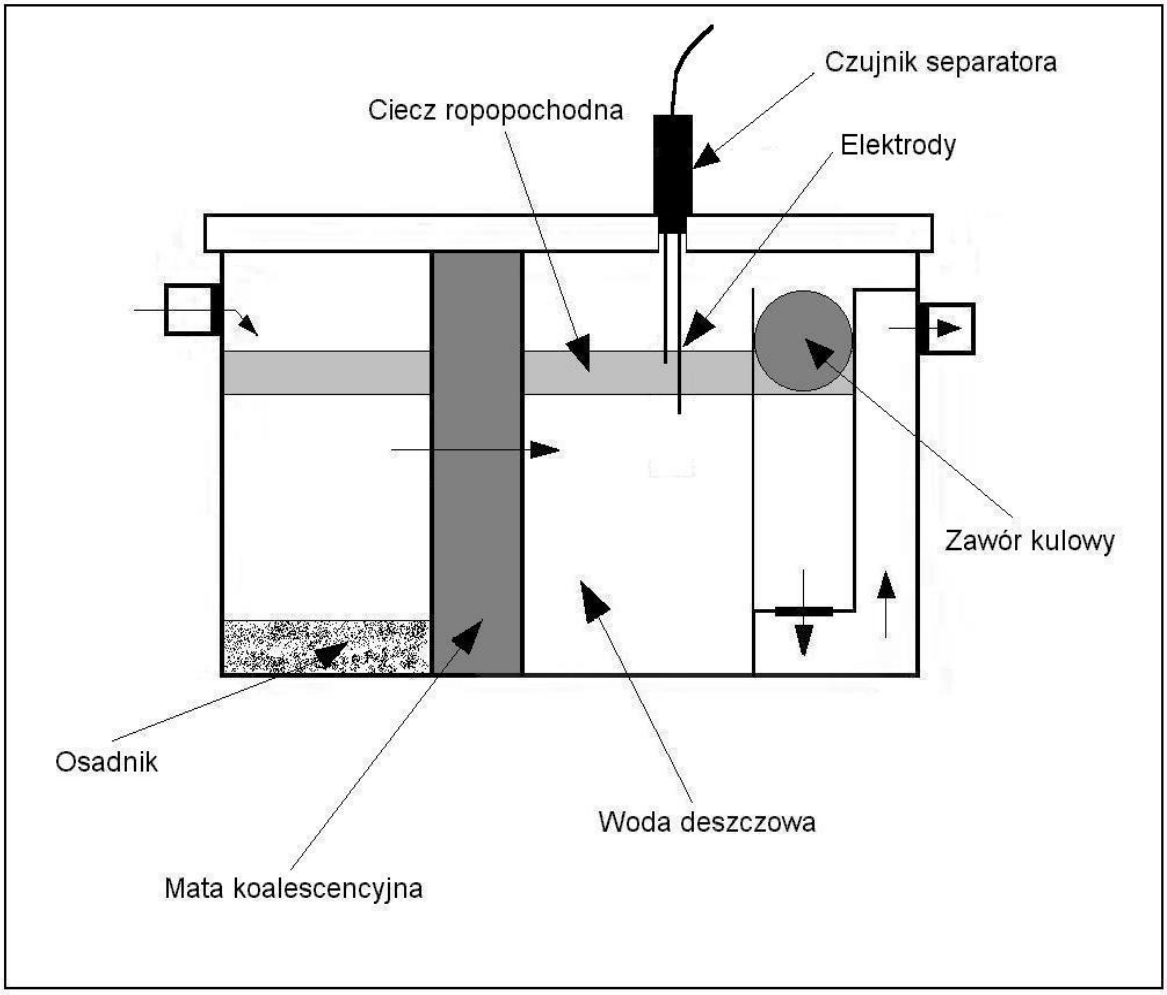

Figure 16: Installation of the separator sensor in the separator.

7.0 Calibration of the central unit

Before you begin calibration of the central unit, turn off the power supply and unfasten all sensors. Then, disassemble the upper cover of the central unit and switch on power supply.

7.1 Setting the alarm threshold

- Switching the set of SWA switches: 1 through 4 in the OFF position, 5 through 8 in the ON position.
- Voltage measurement of measuring point MP0 (for sensor 1) in relation to measuring point MPG (system mass) using a voltmeter,
- The clockwise rotation of the potentiometer located above measurement point MP0 increases the alarm threshold voltage. When it turns counter-clockwise, the voltage lowers.
- After setting the desired alarm threshold for sensor number 1 these activities can be repeated for subsequent sensors (measurement points MP1, MP2 and MP3).

Comments:

By default the reference voltage is set for all channels at 3.0 V!

7.2 Selection of the sensor type

- The type of sensor is chosen by using the set of SWA switches: positions 5 through 8 (for sensors 1 to 4 respectively).
- If a given sensor is supposed to generate low-status alarms (see descriptions of the sensors), then the corresponding switch should be placed in the OFF position.
- If a given sensor is supposed to generate high-status alarms, then the corresponding switch should be placed in the ON position.
- If a sensor with an Open Collector has been installed output in a given position, the respective switch from positions 1 through 4 of the set of SWA switches should be set to the ON position.

7.3 Communication address

- The communication address of the central unit can be adjusted using a set of SWB switches.

Note:

After changing the settings of the SWB switch the device should be restarted made (turn the power supply of the central unit off and on again)!

8 .0 Checking the operation of the central unit

Before you begin checking whether the central unit is operating properly, make sure the central unit is powered.

8.1 Testing the central unit

To check whether the central unit is operating properly perform the following actions: for particular sensors:

8.1.1 Fume sensor

- disassembling the sensor from the tightness control stub pipe,
- placing the sensor in a container with petrol while preventing it from being immersed,
- checking whether the central unit has generated the alarm signal,
- re-assembly of the sensor in the tightness control stub pipe.

8.1.2 LPG sensor

- disassembling the sensor from the tightness control stub pipe,
- "releasing" some gas from the lighter next to the tip of the sensor,
- checking whether the central unit has generated the alarm signal,
- re-assembly of the sensor in the tightness control stub pipe.

8.1.3 Alcohol sensor

- disassembling the sensor from the tightness control stub pipe,
- placing the sensor in a container with ethanol while preventing it from being immersed,
- checking whether the central unit has generated the alarm signal,
- re-assembly of the sensor in the tightness control stub pipe.

8.1.4 Carbon monoxide sensor

- disassembling the sensor from the tightness control stub pipe,
- placing the sensor in a container with carbon monoxide,
- checking whether the central unit has generated the alarm signal,
- re-assembly of the sensor in the tightness control stub pipe.

8.1.5 Optical liquid sensor

- disassembling the sensor from the tightness control stub pipe,
- placing the sensor in a container with water while immersing the prism,
- checking whether the central unit has generated the alarm signal,
- re-assembly of the sensor in the tightness control stub pipe.

8.1.6 Separator sensor

- disassembling the sensor from the separator,
- drying the sensor,
- checking whether the central unit has generated the alarm signal,
- immersing the sensor in a container with water,
- checking whether the central unit has interrupted the alarm,
- re-assembly of the sensor in the separator.

8.1.7 Other sensors

- disassembling the sensor from the tightness control stub pipe,
- placing the sensor in a container with proper medium while preventing it from being immersed,
- checking whether the central unit has generated the alarm signal,
- re-assembly of the sensor in the tightness control stub pipe.

9 .0 External signaling devices

9.1 Connection of external signaling devices

A lamp, a howler and an alarm shutdown button can be connected to the central unit with a TBSIG plug (see figure 3). These elements must be adapted to 12 VDC power supply and connected with proper polarisation.

An example of such connection can be found in figure 17.

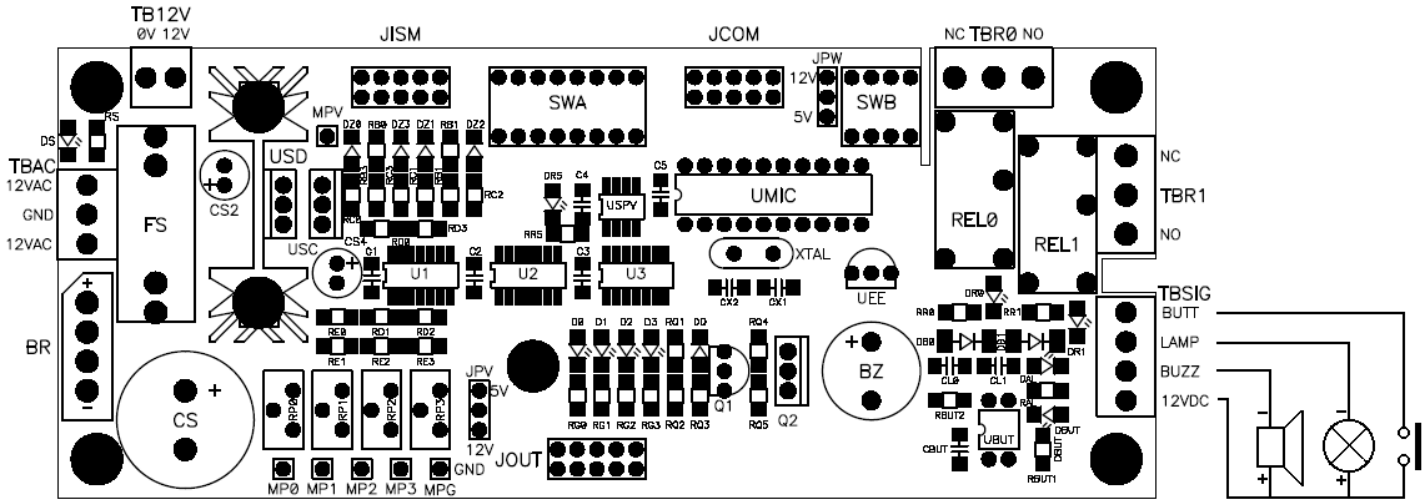

Figure 17: Connection of external signaling devices.