



- **Simplicity of system installation and adjustment**
- **Using of digital temperature sensors**
- **Temperature cables with screen for electrostatic discharge and disturbance protection**

Grain monitoring system is used at grain storage and treatment enterprises for ensuring of safety grain storage technological process and maintenance of grain qualitative indicators.

Grain temperature monitoring is primary importance task during storage of grain. Late detection of fire-fanging zones is able to bring enormous loss for your company.

TCC-02 system is intended for uninterrupted remote measuring of temperature in grain silos, presentation on display of computer information about temperatures in digital form, warning alarm messages when exceeding of set point for critical temperature value or for rate of temperature change. Each temperature cable has several monitoring points. The quality of temperature cables and quality of monitoring points in it is specified by contract.

TCC-02 system is intended for commercial solutions.

#### System set

The main devices of system are following: information acquisition units TCC-AU/01, TCC-AU/02, TCC-AU/03, connection box - splitter TCC-CB/01 and temperature cables.

#### Supply set

TCC-02 system set may consist of:

- information acquisition unit TCC-AU - up to 100 pcs.
- connection box - splitter TCC-CB/01 - up to 1600 pcs.
- temperature cable - up to 1600 pcs.

The system set, temperature cables length, quantity of sensors in temperature cable are specified by contract.

## Design and operating principle

### Temperature cable

Thermometry cable arrangement include special whole sheath. Inside protection sheath from high density polyethylene (HDPE) is incorporated metal carrying rope.

Thermometry cable has several temperature sensors installed at regular intervals. Tiny converters (sensors) of temperature DS18B20 type of «Dallas Semiconductor» company (USA) are used. The sensors are three wires connected in parallel to lead-in cable. Thermometry cable has thimbles for fastening to silo roof pegs (upper thimble) and for lower fastening avoided temperature cable free sagging (lower thimble).

### Information acquisition unit

Information acquisition units TCC-AU/01 and TCC-AU/02 have metallic case. Information acquisition unit TCC-AU/03 has plastic case. Information acquisition units equipped with:

- information acquisition module;
- protection module;
- interface amplifier module (for TCC-AU/02 only);
- glands for external cables;
- terminals external cables connection.

Information acquisition module ensures acquisition and sending of temperature and system conditions data by RS-485 interface to operator PC.

Information acquisition unit is available in three modification:

- TCC-AU/01 – for connection of 16 temperature cables;
- TCC-AU/02 – for connection of 16 temperature cables with RS485 interface repeater;
- TCC-AU/03 – for connection of 24 temperature cables.

### Connection box - splitter

Connection box - splitter TCC-CB/01 is unit in plastic case, equipped with:

- temperature cable connection module;
- glands for external cables.

Temperature cable connection module ensures temperature cable connection to common data acquisition bus of information acquisition unit TCC-AU/03. Module has terminals for external cables connection.

### Software

Software ensures processing and presentation on computer in interactive mode of information received by interface RS-485 from information acquisition unit. Graphic presentation of granary silos and table information about temperatures in each silo displays on the screen of computer. Quantity and structure imaging temperatures depend on temperature monitoring system configuration.

Software consists of two applications:

- thermometry server ensures operation with information acquisition units and recording of temperatures data base;
- thermometry client ensures presentation of information received from server.

Software ensures warning alarm when following situation appearance:

- temperature value exceed critical set point for any of monitoring points;
- rate of temperature change exceed critical set point for any of monitoring points;
- temperature sensor failure;
- connection line with thermometry cable break;
- connection line with thermometry cable short circuit;
- connection with information acquisition unit disappear;
- information acquisition unit built-in ROM failure.

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Besides warning alarm the software also execute following functions:

- information representation for operator about temperatures and temperature change rates in tables;
- temperatures and temperature change rates are indicated both digital form and color gradient field;
- filling level rough estimate function. Filling level is indicated in % from full volume of silo and has graphic presentation;
- recording of data base of all monitoring temperatures for last month Interbase format;
- data base is contained information about each system sensor temperature and equipment conditions;
- flexible adjustments of products storage parameters: input of name and property of storing products in silo, adjustment of products storage parameters, storing product type is specified for each silo;
- warning alarm system has audio and visual indication, list of alarm messages, common sound alarm acknowledgment function and visual alarm acknowledgment for each silo separately, delete alarm messages after eliminate alarm reasons and operator confirm;
- recording of system operation and alarms protocol, temperature change presentation in form of diagram, comparison of temperature changes for different sensors;
- three access levels for system functions and adjustments are provided: browse mode and password protected Operator and Technologist modes;
- monitoring of system operation mode is provided: recording in data base system equipment deactivation, time of client software operation and operator activities, estimate of continues operation mode in %;
- build-in automatic diagnosis function record failure and deactivation of system equipment and classify of equipment failure (temperature sensor, thermometry cable, information acquisition unit) or connection failure (connection line break, connection line short circuit) system topology reference;

- forming and printing of reports in form of tables and graph, possibility of export of tables information into MS Excel;
- function of integration into SCADA is implemented by OPC server, embedded in our software.

### **Installation instructions**

Information acquisition units should to be rigid installed near a silo and earthed. Connection box - splitter should be installed on vertical surface of silo.

Properly operation of information acquisition unit is possible with appropriate it set of temperature cables. Therefore it is very impotent to install sets of temperature cables and information acquisition units rightly. The table of correspondence between information acquisition numbers and temperature cables sets is passed with maintenance documentation.

In case of wrong installation of temperature cables automatic reconfiguration of information acquisition units is possible with special software.

Temperature cables are installed according to silo temperature cables location diagram with mandatory observance temperature cable numbers. Number of temperature cable is indicated near upper fastening point of temperature cable.

Construction of temperature cable fastening in upper point should be robust, load stabile and to rule out the possibility of spontaneous demounting of temperature cable.

Temperature cable fastening in lower point should be robust and to rule out the possibility of free sagging of temperature cable, as it may be cause of temperature cable break. We advise to use tightening screws for ensuring this requirement.

Screens of lead-in cables should be earthed when temperature cables with screen used.

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Lead-in cables laying and connection to information acquisition units and connection box - splitters are executed according to diagram (see further) with a glance of following requirements:

- use glands for entrance of cables into silo constructions;
- cable from temperature cable to information acquisition unit or connection box - splitter should not be lay near high-current cables at distance less than 300 mm;
- lead-in cable should have free loop with radius not less than 80-100 mm between first fastening and temperature cable for possibility movement of temperature cable fastenings during grain loading and unloading;
- cable should be lay on cables constructions and surely fastening by cable ties;
- fastening of cable to silo constructions is allowed if them are motionless and do not have sharp edges;
- do not use extra force when connect lead-in cable wires to terminals of or connection box - splitter.

Supply feeder of information acquisition units should be protected against short circuits by automatic circuit breakers. Cascade power supply of information acquisition units (from unit to unit) is allowed not more 10 units for one supply feeder.

Granary operator computer should have RS-485 port. Using of interface board of third-party manufacturer (ICP DAS, Advantech, Octagon and etc.). In this case follow the installation and operation instruction for this device carefully.

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## RS-485 network topology

Communication cable connection should be executed by continuous topology (from unit to unit, fig.2). Communication cable should not be lay near high-current cables at distance less than 300 mm.

If you need network tapping use information acquisition unit TCC-AU/02 with interface repeater (amplifier, fig.1). Network topology, quantity and type of information acquisition units are specified in contract.

Data communication cable with twisted pairs and double screen for outdoor laying should be used as data line, for example 3105A cable Belden company or similar.

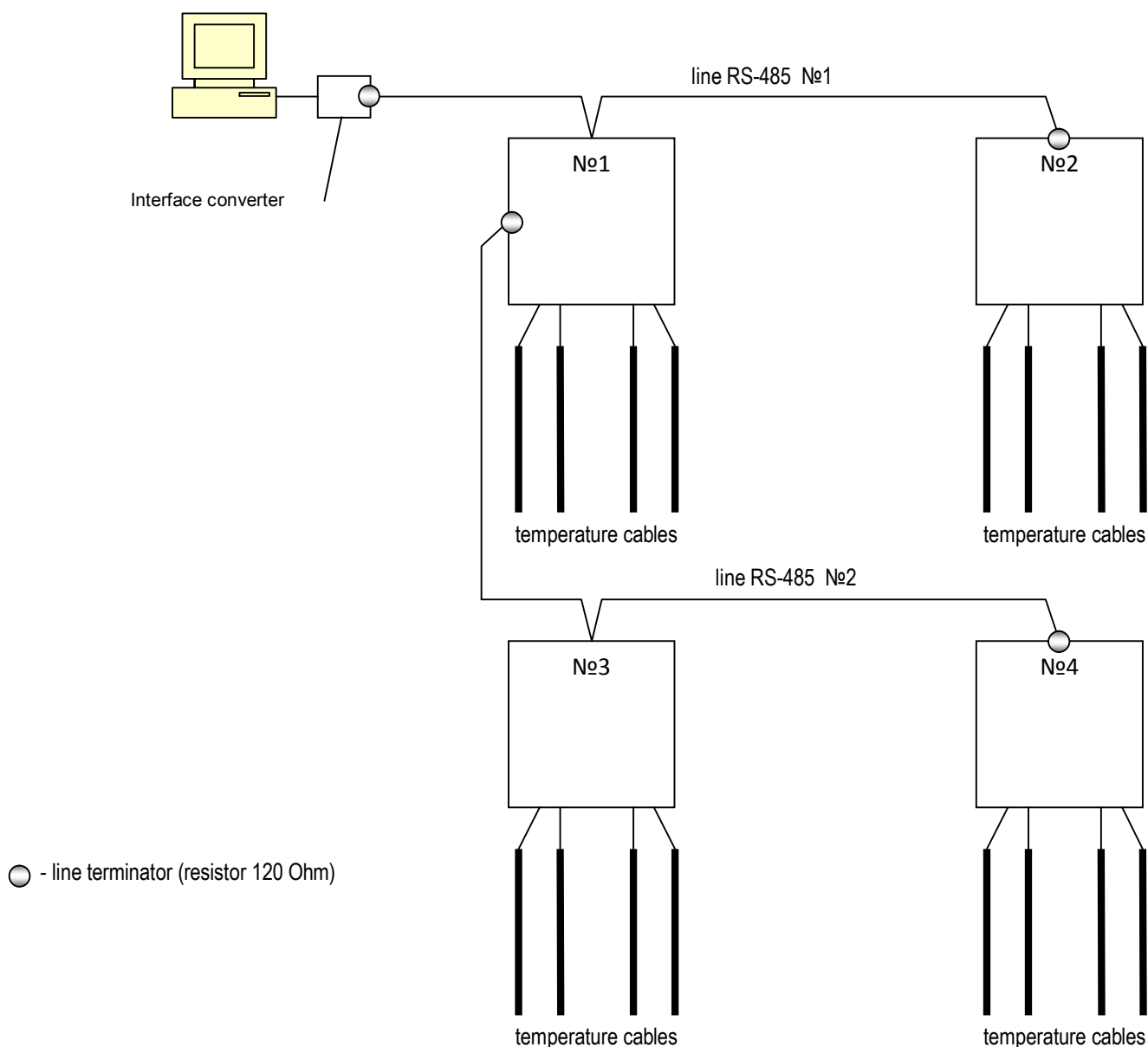


Fig.1

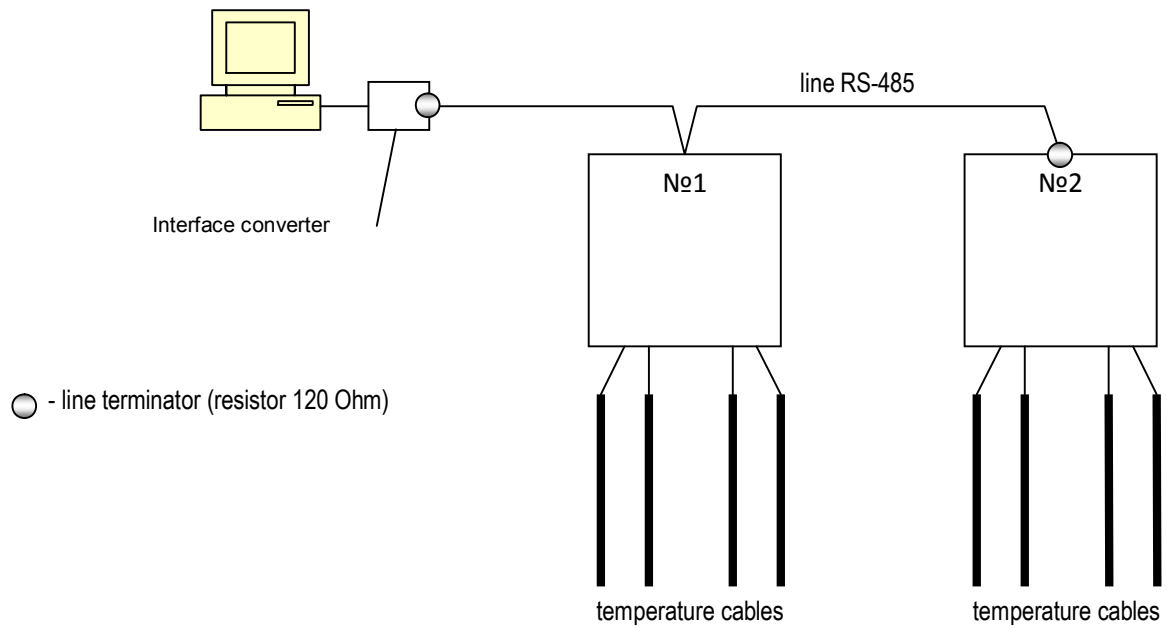
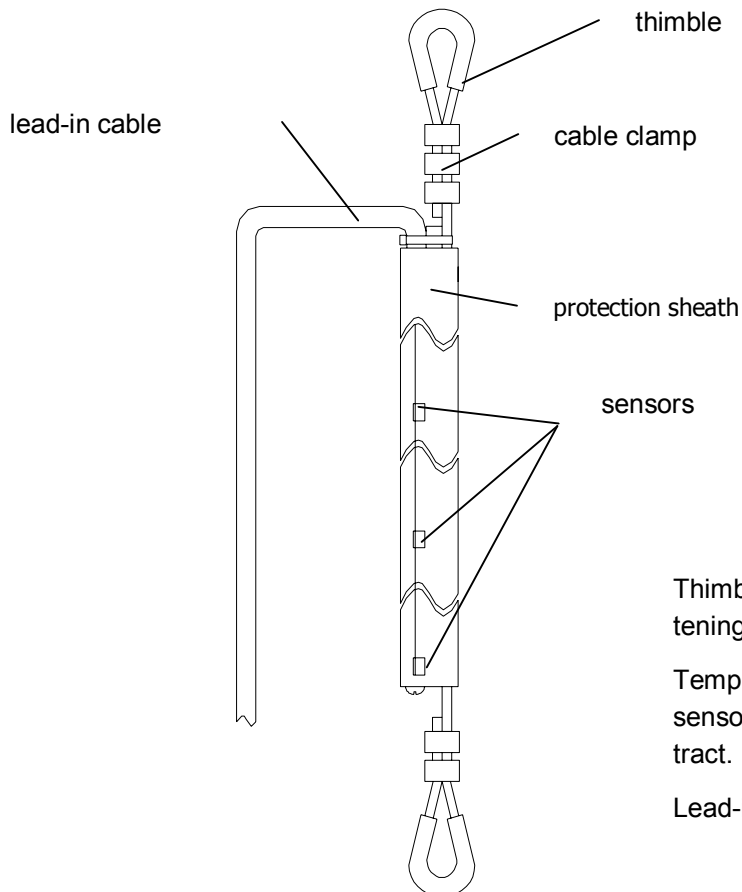


Fig.2

## Dimensions

### Temperature cable

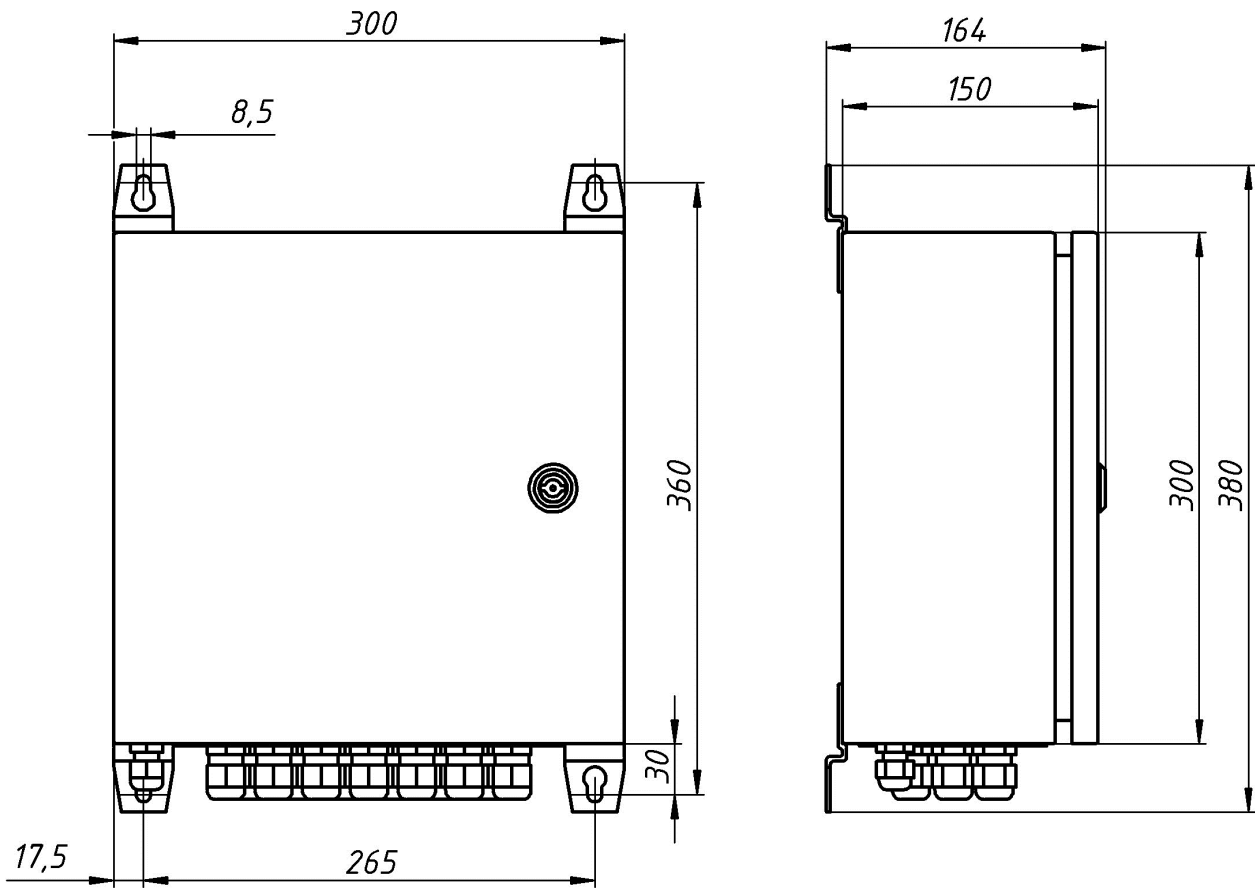


Thimble of temperature cable is intended for fastening peg with diameter 14 mm.

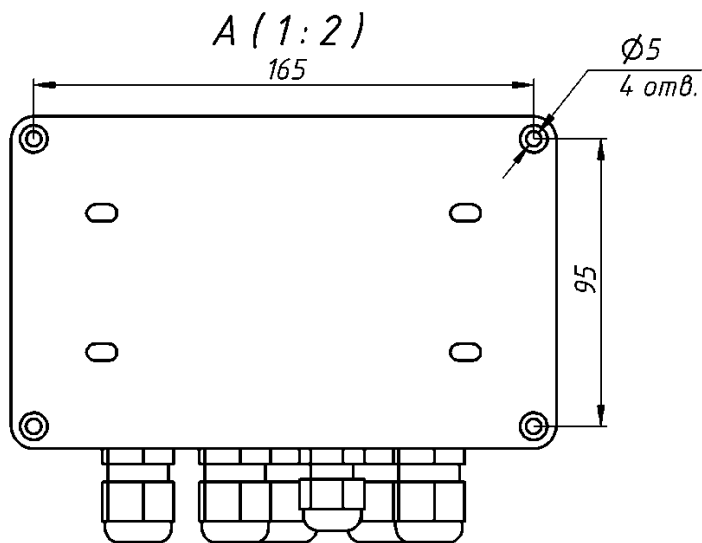
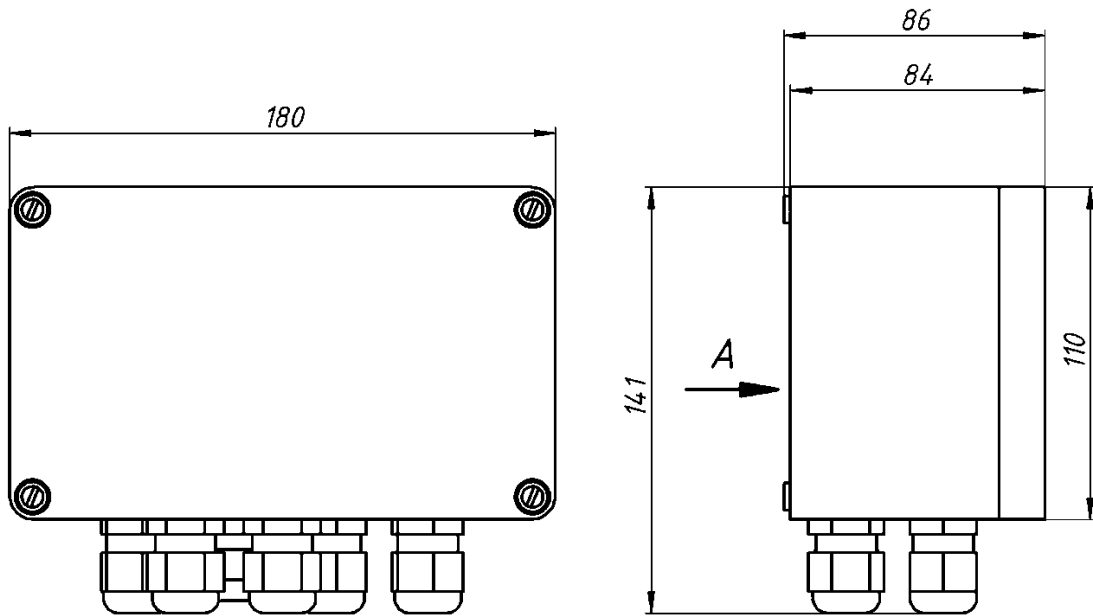
Temperature cables length and distance between sensors in temperature cable are specified by contract.

Lead-in cable length is specified by contract.

Information acquisition unit TCC-AU/01, TCC-AU/02

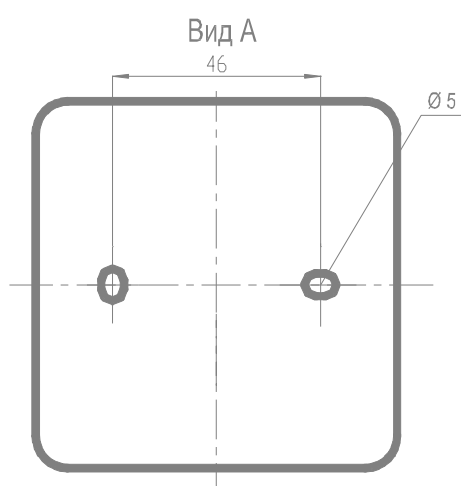
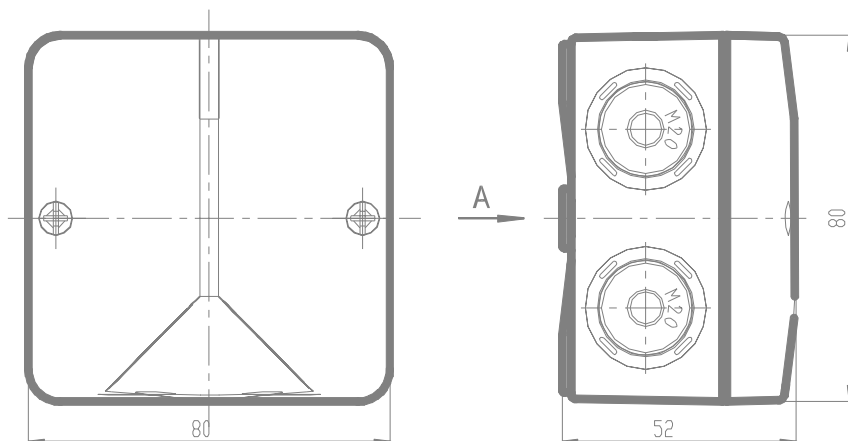


Information acquisition unit TCC-AU/03

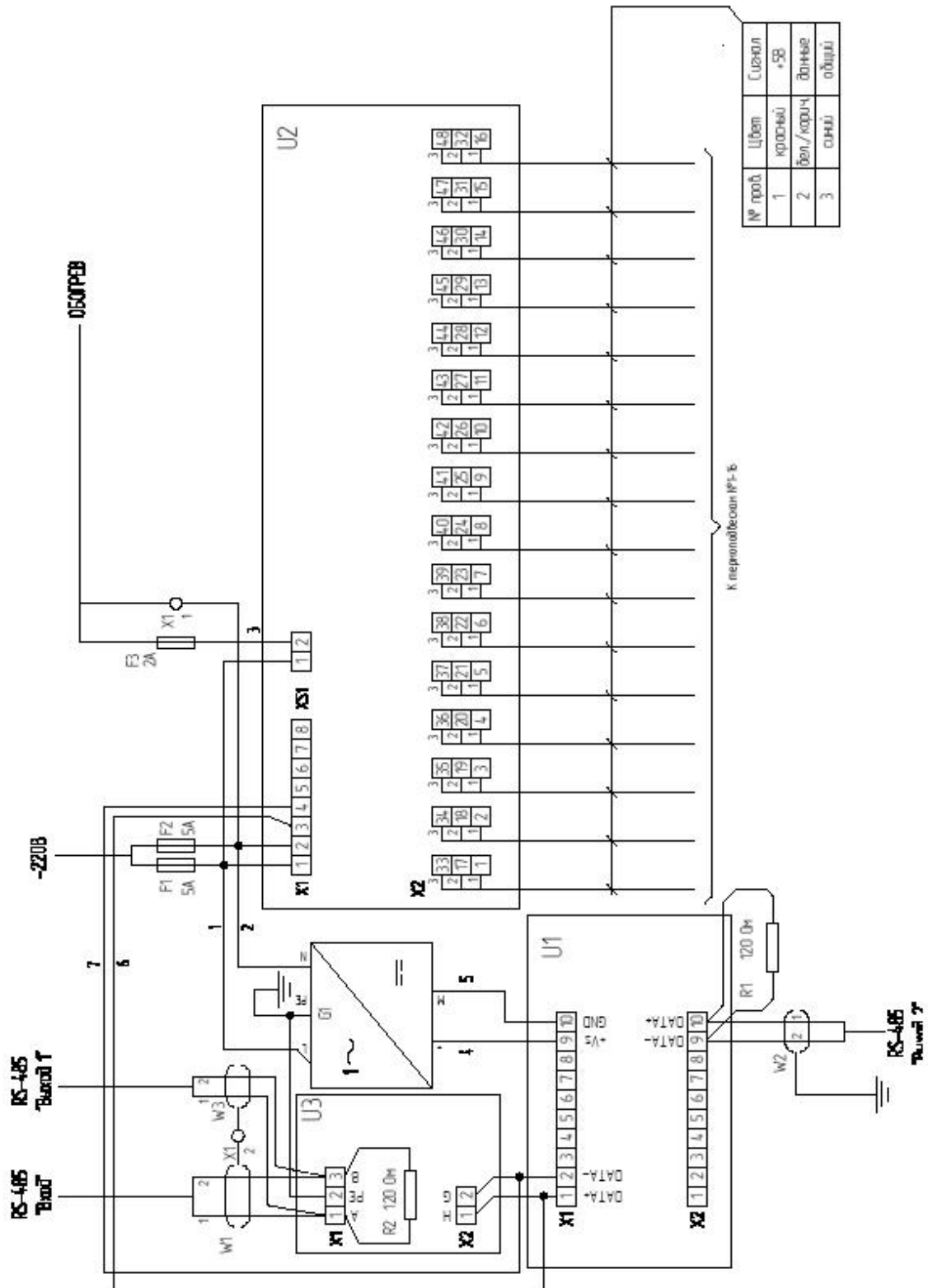




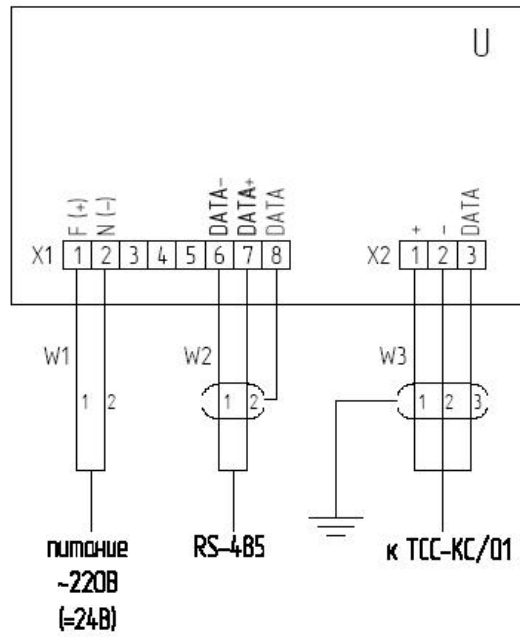
Connection box - splitter TCC-CB/01



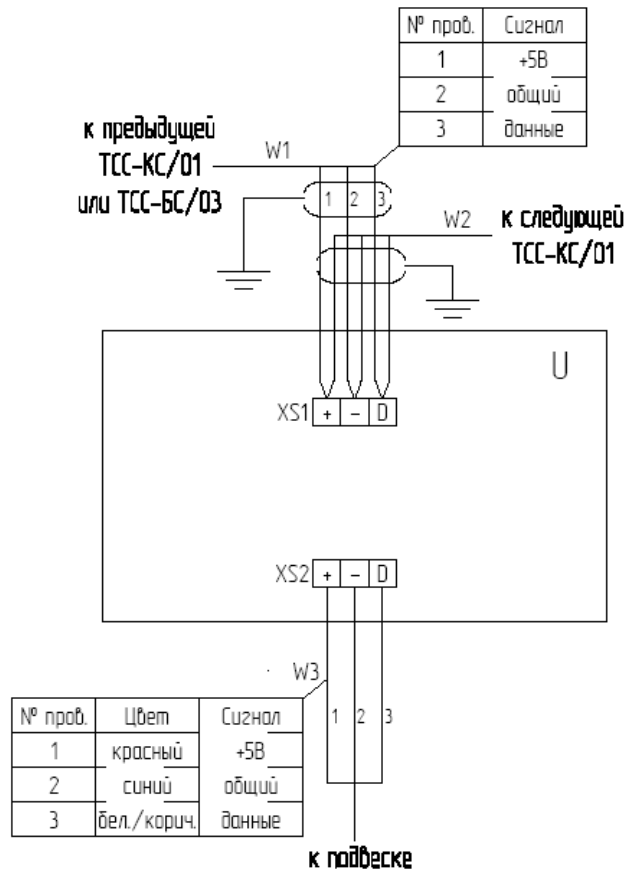
Information acquisition unit TCC-AU/01, TCC-AU/02.  
Electrical connection diagram



**Information acquisition unit TCC-AU/03.  
Electrical connection diagram**



**Connection box - splitter TCC-CB/01.  
Electrical connection diagram**



## Technical data

### Temperature cable

Measured temperature:	- 55...125 °C
Power supply:	5 VDC (from acquisition unit)
Protection Class:	IP55
Length:	4...30 m
Quantity of sensors:	1...32

### Information acquisition unit TCC-AU/01, TCC-AU/02

Quantity of connected temperature cables:	16
Power supply:	24 VDC or 220 VAC
Current Consumption:	max. 400 mA
Protection Class:	IP54
Environmental Temp.:	-30°C ... +45°C
Weight:	5 kg

### Connection box - splitter CB/01

Quantity of connected temperature cables:	1
Protection Class:	IP55
Environmental Temp.:	0°C ... +45°C
Weight:	0,6 kg

### Information acquisition unit TCC-AU/03

Quantity of connected temperature cables :	24
Power supply :	24 VDC or 220 VAC
Current Consumption :	max. 400 mA
Protection Class :	IP55
Environmental Temp.:	0°C ... +45°C
Weight:	1,1 kg