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ГБ05

«STRUNA»

Measuring system

Operator’s Manual

КШЮЕ.421451.001РО3

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The Operator's manual (hereinafter referred to as OM) is dedicated for studying of the operator's interface with measuring system «STRUNA» (hereinafter refered to as system), contains data on adjustment and operation of the system in working modes, trouble shooting, density measuring channel adjustment and conjuction of measuring channel to a tank.

The OM doesn't contain data on the system operation with software installed on the consumer's hardware and is distributed to the software systems of the computing unit (CU) 9648 and higher.

The following abbreviations is used in the manual:
AWL – Water Level Alarm;
CD – Computing Device;
CFL – Corrosive and Food Liquids;
CM – Control Module;
DO- Diesel Oil;
DS – Density Sensor;
DSC – Density-sensing Channel;
GFS –Gas-filling Station;
IU – Indicating Unit;
JB – Joint Box;
LS – Level Sensor;
LSC – Level-sensing Channel;
MS – Measuring System
PC – Personal Computer;
PP – Petroleum Products;
PPR – Primary Parameter Reorganizing Sensor;
PrS – Pressure Sensor
PS – Petrol Station;
PSC – Pressure-sensing Channel;
PSU – Power Supply Unit;
TS – Temperature Sensor;
TSC – Temperature-sensing Channel;
WLAC – Bottom Water Level Alarm Channel;
WLS – Water Level Sensor;
WLSC – Bottom Water Level Sensing Channel.

1 Means of Information Input and Display

Input and display of information are performed by IU.

Display of information is done on the 2-string 16 bit indicator.

Input is done from a keyboard consisting of 16 buttons. Buttons functions depend on the recent working system mode.

IU contains an integrated speaker allowing to acomplish the sound alarm.

IU panel view is given in picture 1.1.

Figure 1.1.

2 System Functional Modes

Initialization mode is a short-term system state after the power supply is switched ON or when exiting the adjustement mode. The system does primary hardware testing, configuration analysis and is preparing to function in one of the working modes. The transit to the measuring mode is accompanied by the primary gathering of the information on the measuring channels.

Measuring mode is an operational mode in which the system does cyclical gathering, control and display of the measuring information.

Gauging mode is an operational mode that is a process option of the measuring mode. Please refer to section 7 for more detailed information.

Adjustment modes are intended for system preparation to functioning in operational modes.

3 Initialization Mode

Within 1s after turning ON the power supply on the IU indicator the following message is to be received (see figure 3.1 a), accompanied by the sound signal. Further the number of software version YYYY is transmitted to the indicator (see figure 3.1 b). The duration of the initialization is less than one minute from the moment of turning ON the power supply.

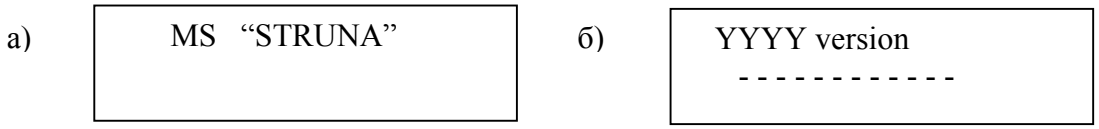


Figure 3.1

If that initialization goes successfully, the system switches to the working mode, in other case the error massage is received. The types of initialization error messages and possible operator's actions are reviewed in section 9.

4 Measuring Mode

In the measuring mode the measuring system does:

- gathering and display of the measured information on liquid parameters (level, volume, temperature, density, liquid mass, underwater level);
- gathering and display of the measuring data on pressure (for GFS);
- control of measuring parameters in line with the operator's criteria and critical states parameters alarm;
- trouble shooting.

The measuring mode is entered automatically at the end of the initialization at the same time the parameter of the first active channel of CU connection is transmitted to IU screen (depending on the configuration). For PPR cnahhel the level (see subsection 4.2) or volume (see subsection 4.3) is transmited, for channel of PrS group the pressure (see subsection 4.8) is transmitted.

4.1 Operating with screen and IU keyboard philosophy

Block-charts of the measuring means are presented at figures 4.1 a), 4.1 b).

Function of keyboard buttons:

Button	Function
"0"	Pressure values review
"1"	Mass values review
"2"	Density values review
"3"	Temperature values review
"4"	Volume values review
"5"	Underwater level values review
"6"	Parameter selection
"7"	Level values review
"8"	Parameter values differentiation review
"9"	Process parameters values review
"+"	Channel selection
"-"	Channel selection (reverse)
"MC"	Enter to the settings mode
"EX"	Enter to the configuration mode
"MR"	Enter to the additional settings mode
"."	"Acceptance" command

Buttons "0", "1", "2", "3", "4", "5", "7", "9" determine parameter type depicted at the IU screen.

"6" button consequently switches parameter types.

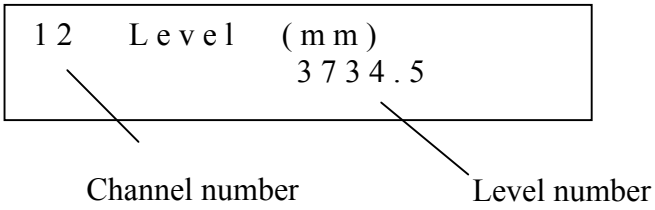
"+", "-" buttons serve for the channel number selection.

The "MC", "EX", "MR" buttons change the sytem operating mode. Their functions will be reviewed in section 5.

Buttons "8" and "." functions are reviewed in subsection 8.5.

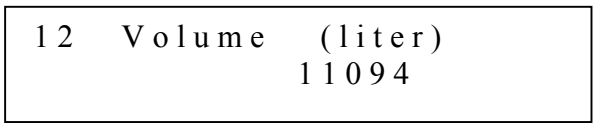
4.2 Level values review

Level values are depicted by pushing button "7". The level values of the current channel are depicted at the IU screen in millimeters:



4.3 Review of the volume values

The depiction of the volume values starts by pushing button "4". If the gauging tanks tables (see subsection 6.4) are entered into the system, the liquid volumes are depicted at the IU screen for the current channel in liters:



If the graduation table for the current tank is not available the "OFF" state is shown at the indicator:

```
12  Volume    (liter)
              OFF
```

4.4 Level values of bottom water

The bottom water level in mm is depicted by pushing button "5".

```
12  Water     (mm)
              XX
```

4.5 Temperature values review

The depiction of the average liquid temperature in °C is depicted by pushing button "3". Temperature depiction sample:

```
12 Average tempeature (°C)
                    +10.7
```

By further pushing button "3" the depictions of temperature values "temperature 1"..."temperature N" are shown (please see figure 4.1a), corresponding to the temperature sensors (TS) 1 ... N. Number (N) TS and settings coordinates on the tank height are given in the system passport КШИЮЕ.421451.001ПС.

4.6 Review of density values

The average liquid density in kg/m^3 is depicted by pushing button "2". Density depiction sample:

```
12 Average density (kg/m3)
                     751.2
```

Further pushing of button "2" start depictions of the density values "ar. Density 1" …" ar. Density N" (see figure 4.1a), corresponding to density meters 1…N. The number (N) of density meters and settings coordinates for the tank height are given in the system passport КШИЮЕ.421451.001ПС.

Minimal product level in the tank necessary for density meters operation is given in Attachment A of the КШИЮЕ.421451.001РЭ Manual.

4.7 Mass values review

Depiction of liquid mass values starts by pushing button "1".

Mass depiction sample:

```
12  Mass      (kg)
              1751.2
```

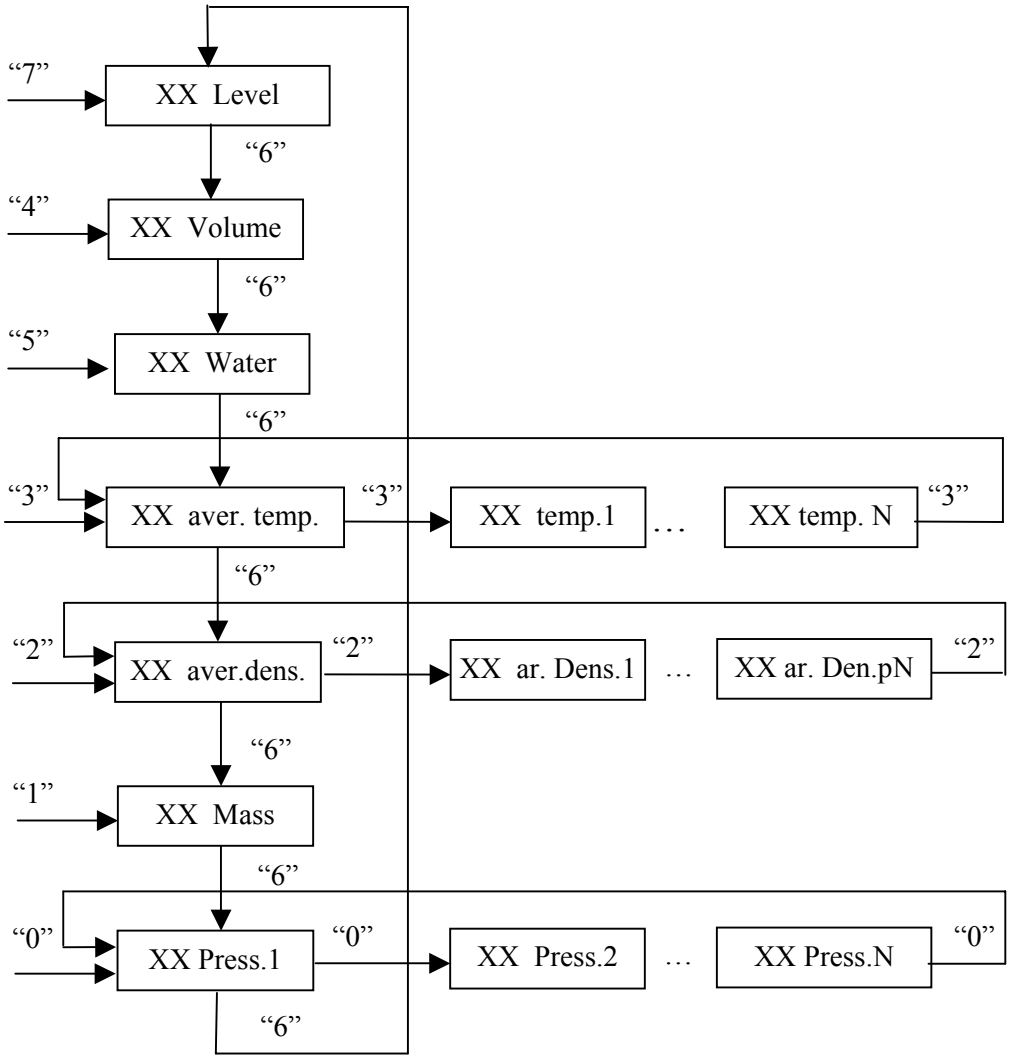


Figure 4.1a – Basic parameters review

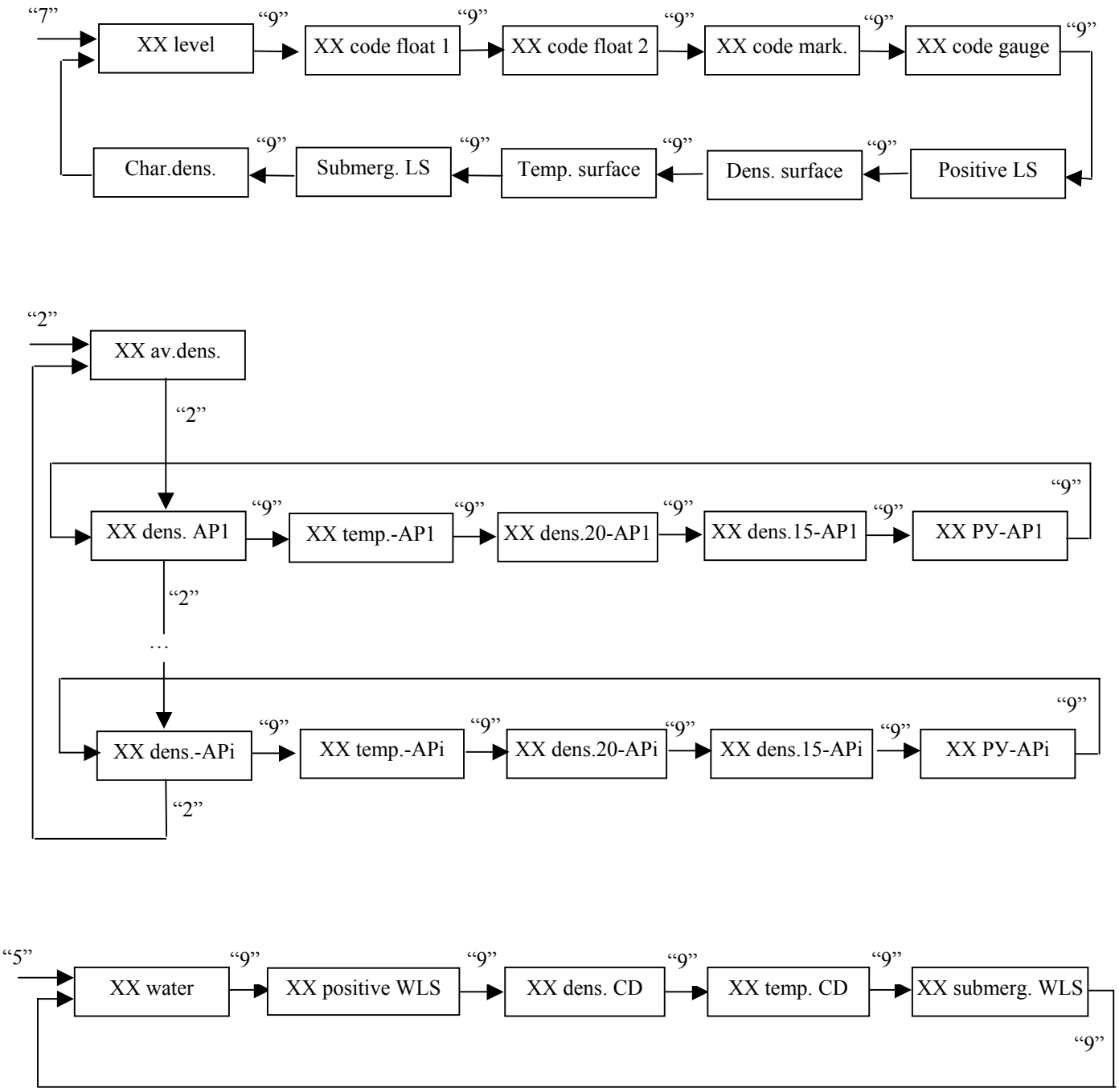
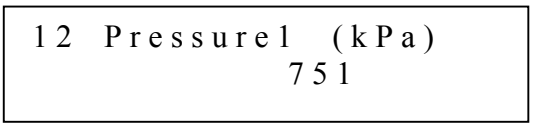


Figure 4.1b Review of process parameters

4.8 Review of pressure values

Depiction of pressure values corresponding to PrS1is started by pushing button "0".
Pressure depiction sample:



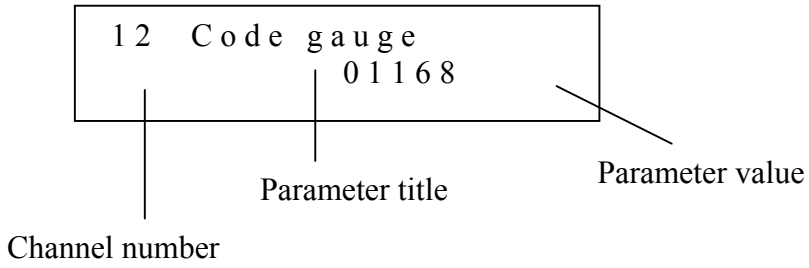
Further pushings of "0" button start the depiction of pressure values "Pressure 2" … "Pressure N" corresponding to PrS2 … PrSN. the number (N) of PrS is indicated in the system passport КШИЮЕ.421451.001ПС.

4.9 Review of process parameters values

The group of process parameters is formed for some main parameters that are used for system setting at the manufacturer's plant and for testing.

It is necessary to choose the main parameter by pushing of the corresponding button. Then to set the depiction of the process parameter needed by the consequent pushing of button "9" (see figure 4.1 b).

Depiction sample:



4.10 Errors depiction

The errors depiction in the measuring mode is presented in section 9.

5 Setting Modes

5.1 IU screen and keyboard philosophy

5.1.1 Block diagram

Please refer to the block diagram at figure 5.2 a. The block-diagram consists of rectangulars (block-chart points). Point depiction at the block-diagram must have a title and can contain a list of states options.

The special depiction of IU at the screen corresponds to each point that obligatorily includes the point title and can contain the state (or value) of the point and indicators of transmission to other chart points.

The points at the block-chart are connected with vertical and horizontal links that show possible transitions between points. Each link is accompanied by a symbol in brackets that corresponds to the button of IU keyboard. The indicated button initializes the link transition.

The point having the state (or value) is a point of system setting. Hereinafter when there's a reference to the setting point the following registration will appear:

Mode / point 1 (state) / … /Point N (state) / Setting point **1 (state), … , Setting point M (state), …**

Field "Mode" – title of the block-chart containing the setting point.

Fields "poit 1…N" – intermediate points of pass at the chart.

Field "setting point 1…M" – one or more setting points. If several points are indicated they refer to the constants group (see below).

Field "(state)" – the required point state (may be absent). If the state is shown for the intermediate point then it determines the possibility of the next pass. The searched state is taken for the setting point.

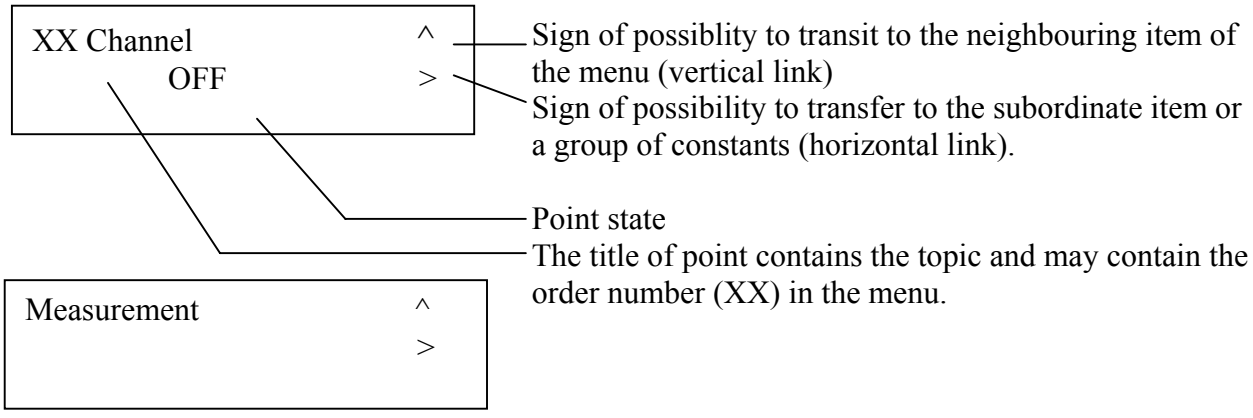
Points may be combined in groups. There're two group types: menu and constants.

5.1.2 Menu

Menus are presented at the block-chart as tables consisting of points that are combined by vertical links.

Menu points may create the subordinate menu or have a set of number and/or logistic constants that show horizontal chart links.

A few options of menu point depiction are shown at IU screen:



Buttons functions:

Button	Function
"9"	Transition between menu options
"6"	Transition between menu options (reverse)
"–"	Change of the menu option state
"+"	Enter to the subordinate menu or subordinate constants group
"0"	Exit from the previous menu

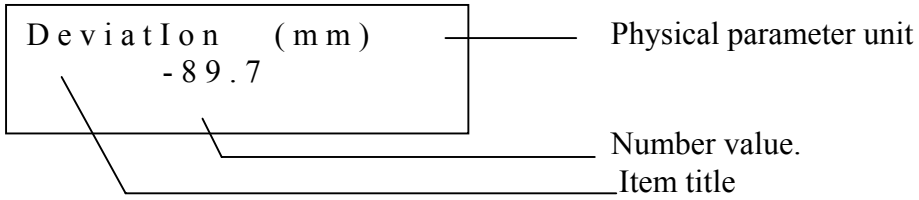
It is possible to return to the corresponding point of the previous menu from any point of the given menu by means of "0" button till exit of the setting mode.

5.1.3 Number or logistic constants

The group of constants is subject to the menu option and is a closing option for horizontal pass at the chart. It is necessary to consequently pass each point of the group by means of "+" button to return to the initial menu point.

There're two possible points of constants input:

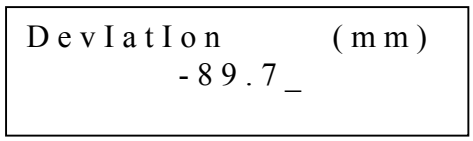
a) **number constant** point. The type of point in the review mode.



Buttons functions:

Button	Function
"EX"	Enter to the edit mode
"+"	Transmit to the next item

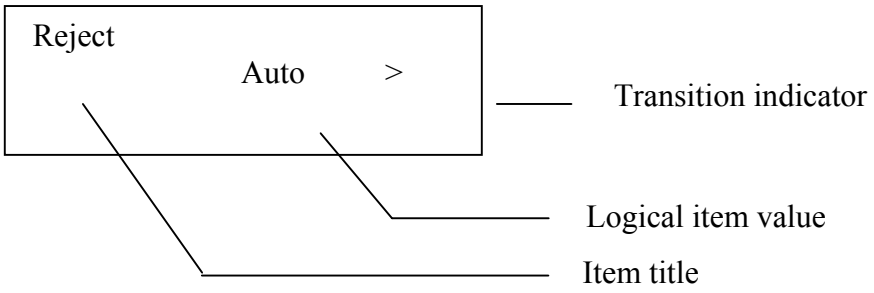
Item view in the edit mode:



Buttons functions in the edit mode:

Button	Function
"–"	Minus number sign
"0"…"9"	Number input
"."	Separator of whole and …number part
"EX"	Return to the original number value if a new value is not put correctly
"+"	Confirmation of number input, return to display mode

б) Item of **logic constant** input. Item view:



Buttons functions:

Button	Function
"–"	Value change. The value is chosen from a fixed set.
"+"	Input confirmation. Transition to the next item.

5.2 Samples of work with block diagram

The target setting: enter value "-112,5" as a deviation of the level switch scale for the 5th measuring channel. The passway to the setting point:

Setting mode/Tanks / 05 tank / **Deviation/deviation (mm).**

Original system state is the measuring mode. Operator's actions are according to the block diagram of the setting mode (figures 5.3a, 5.3b):

a) activate the setting mode by pushing "MC" button. Type code in the appeared screen "password" (see subsection 5.3), push button "+". If the password is correct the screen "tanks" appears, otherwise – return to the measuring mode;

b) item "tanks" is located in the first menu of setting mode. (The first menu allows selecting the setting mode). Item starts the subordinate menu that confirms ">" indicator in the right down corner of the screen. Press button "+" to pass into the subordinate menu. The initial screen of item "01 Tank" of the second menu will appear;

c) menu "XX tank" allows to select the number of the measuring channel (tank). Selection of items is done by buttons "6" and "9" till the screen setting "05 Tank";

d) any item of menu "XX tank" generates the menu of the individual tank characteristics. Push button "+" to pass to the third menu. The "deviation" screen appears.

e) item of menu of tank characteristics "deviation" according to the block diagram allows passing to the item of constant number. Push button "+". The "deviation (mm)" screen appears;

f) switch item to the editing mode by pushing button "EX". In the field of the parameter number value enter number "-112,5" by consequently pushing buttons "-", "1", "1", "2", ".", "5". If the number of figures is not correct it is possible to remake the original value by pushing button "EX". The entrance is confirmed by "+" button, after that the menu item "Deviation" is returned. (In this case the constants group consists of one item only);

g) exit from the setting mode is done by consequent pushing of "0" button. The system switches to the initialization mode and then to the measuring mode.

Please review the extended task. Suppose it is necessary to change the item state "Product" to "Diesel Oil" in addition. The parameter settings are as follows:

Setting mode/Tanks /05 tank /**Product (Diesel Oil)**

The previous action scheme must be different at step g):

g) pass within the menu of tank characteristics to item "Product" with help of buttons "6" and "9". Change the state of this item with button "-" to the view "Diesel Oil";

h) exit from the setting mode is similar to the one indicated above.

5.3 Block diagrams of setting modes

Mode	Block diagram	Entrance button	Password
Configurations	figures 5.2 a, b	"EX"	23814
Settings	figures 5.3 a, b	"MC"	11907
Additional settings	figure 5.1	"MR"	35721

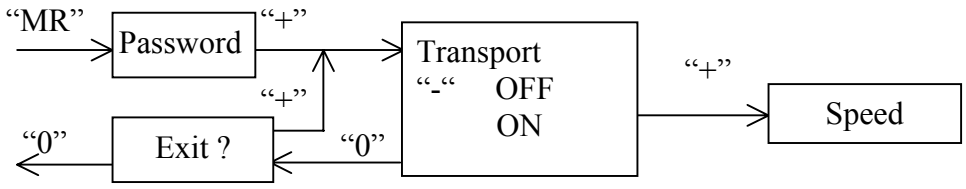
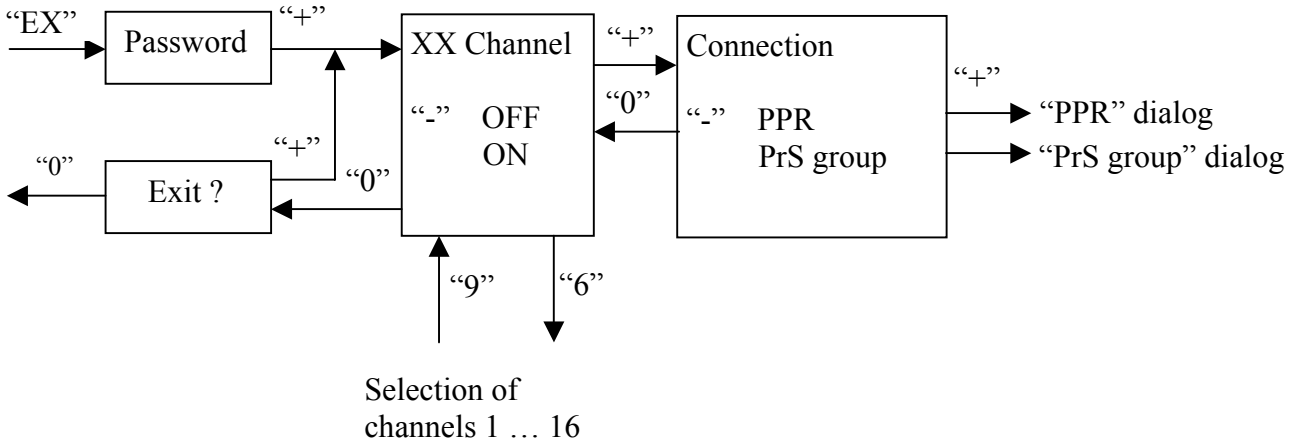
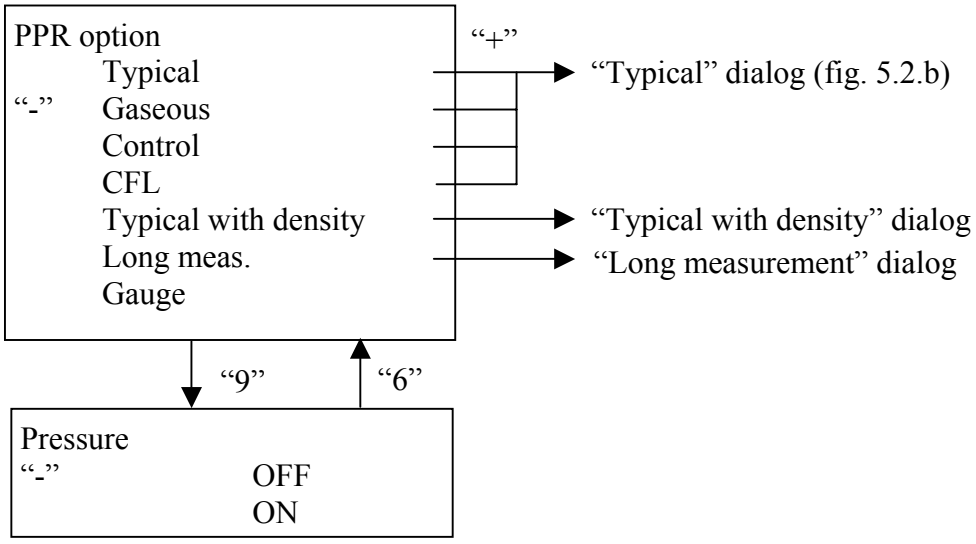


Figure 5.1 Additional settings mode



PPR dialog



"PrS group" dialog

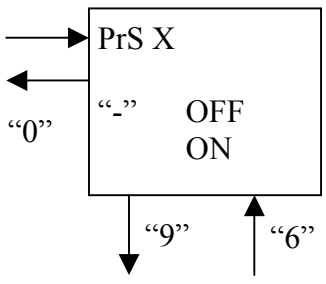


Figure 5.2.a – Configuration mode

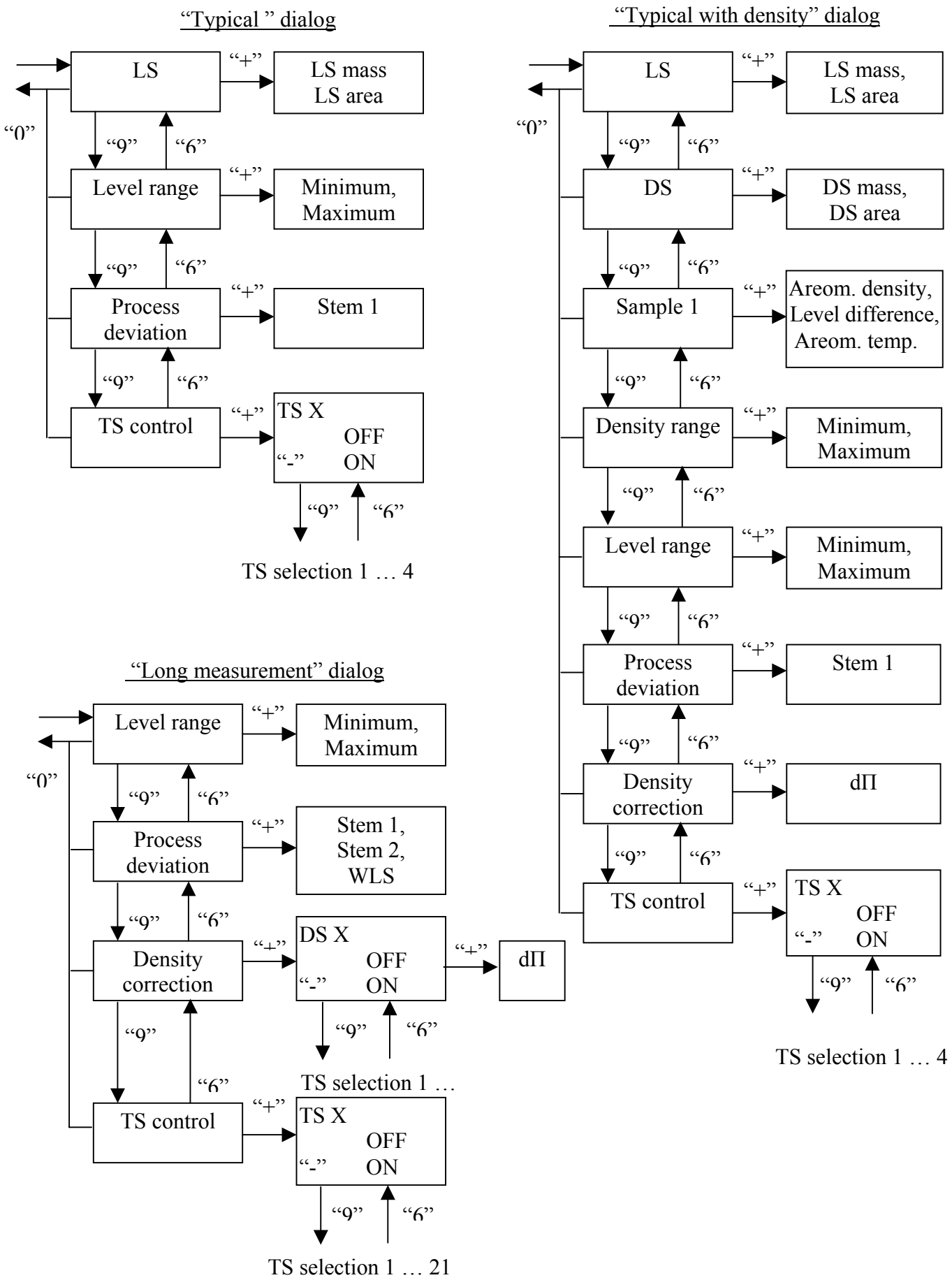
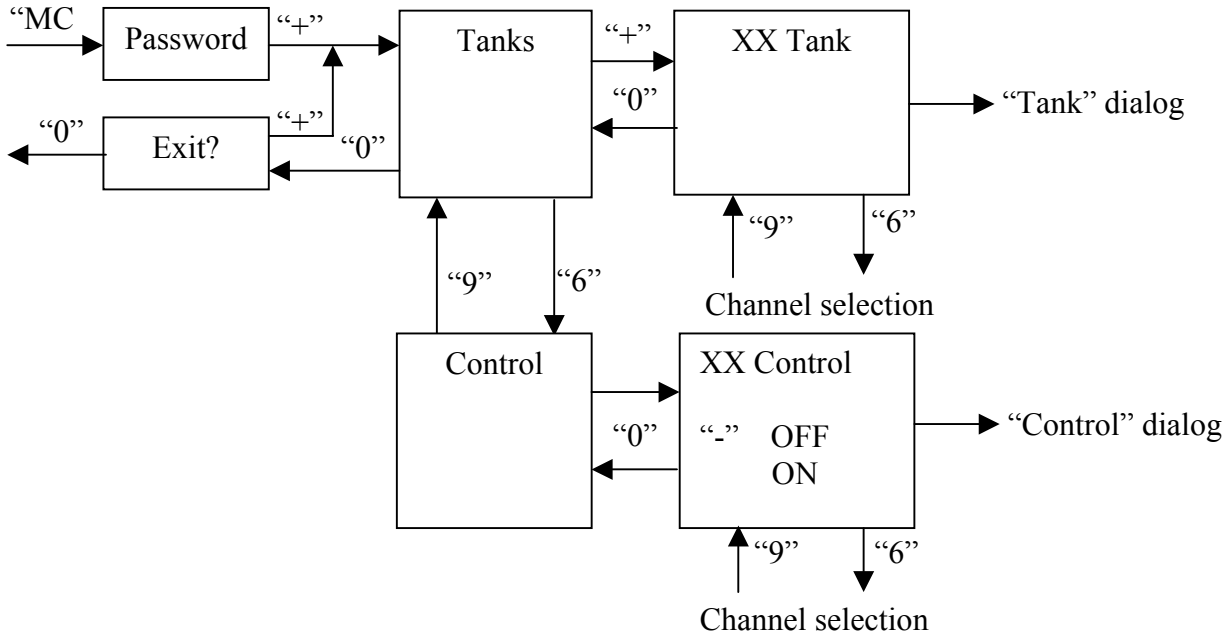


Figure 5.2.b – Configuration mode (continuation)



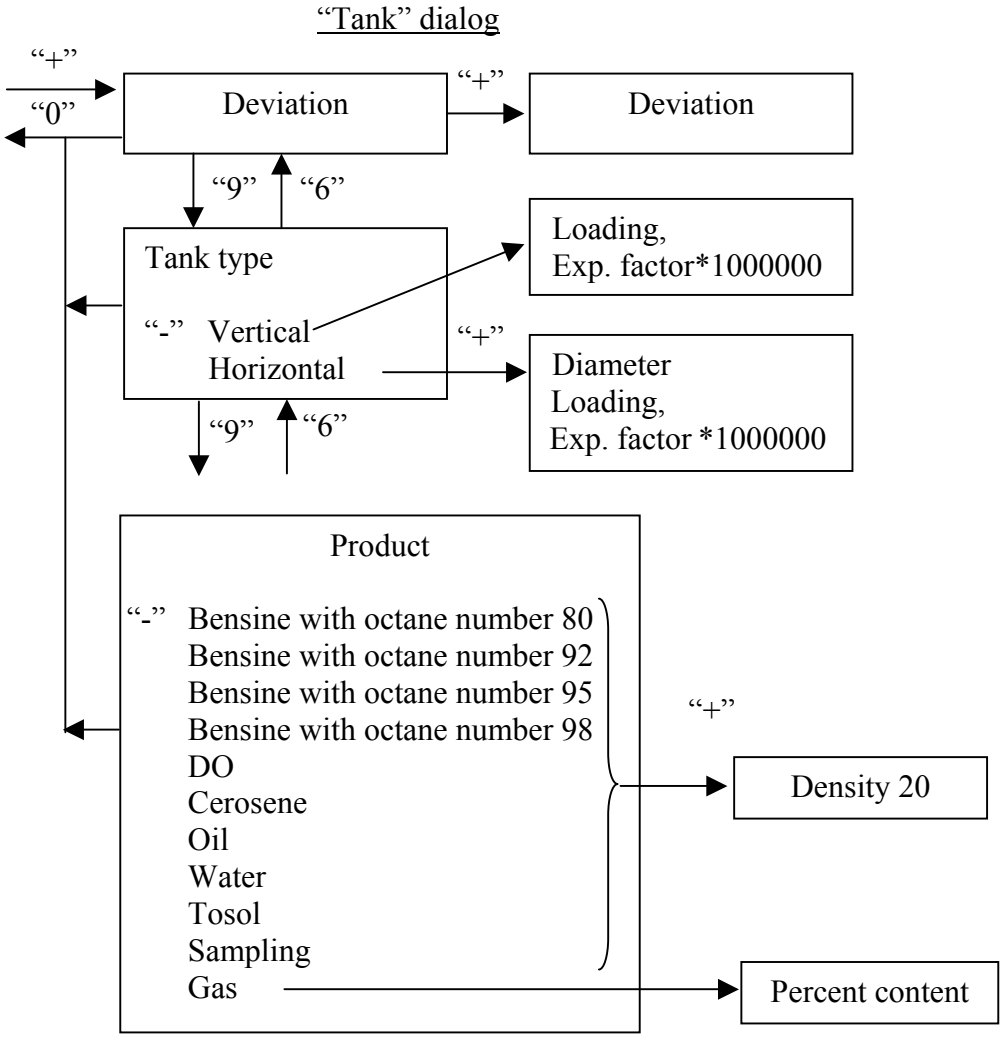


Figure 5.3.a – Setting mode

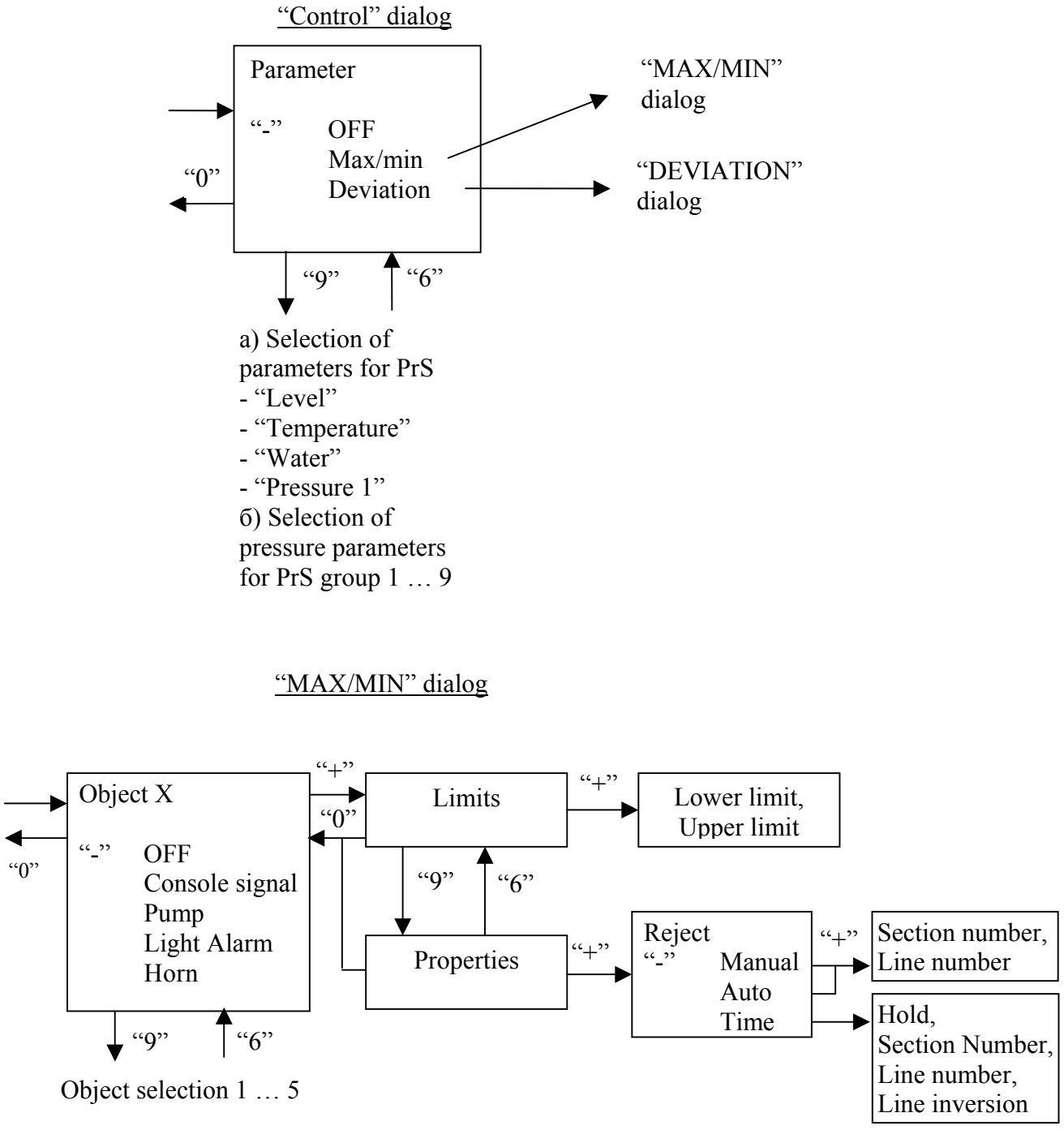


Figure 5.3.b – Setting Mode (continuation)

6 Measuring Mode Setting

NB! The setting is done in the scope of the given original data at system ordering at the manufacturer.

Setting determines the hardware set and meteorological constants of the indivisual system design according to the passport for КШИЮЕ.421451.001ПС system.

6.1 The setting in the additional settings mode

Set a parameter "transport" in the "OFF" state:

Additional settings mode/ **Transport (OFF)**

6.2 Setting in the configuration mode

Item "XX Channel" is to be set in"OFF" state if CU has a corresponding channel of PPR connection or PrS group and if there's a necessity in measurements on this channel.

Configuration mode/**XX Channel (OFF)**

Indicate the connection option: "PPR" or "PrS group".

…**XX Channel/Connection**

6.2.1 For PPR selection the channel set is to be set on items:

… **PPR option/XX Channel/Connection (PPR)/ PPR option**
…/ XX Channel/Connection (PPR)/Pressure

The items state is determined in line with the table:

PPR indication КШИЮЕ.407533. … (passport table 4.3)	Setting items state	
	"PPR option"	Pressure 1
001	"Typical"	OFF
001-01	"Typical with density"	
005	"CFL"	
006	"Control"	
001-02, 001-03, 002, 002-XX, 005-01	"Long measurement"	
003, 003-01	"Gas"	ON
003-02, 003-03	"Long measurement"	

PPR option determines a list of other characterisitics that are set on items:

…**PPR option/LS/LS mass, LS area**
…**PPR option/DS/DS mass, DS area**
…/ PPR option/sample 1/ Areometer dens., Level difference, Areometer temp.
…/ **PPR option/Dens. Range/Maximum, Minimum**
…/ **PPR option/Level range/Maximum, Minimum**
…/ PPR option / Process deviation / **Stem1, Stem 2, WLS**
…/ PPR option / DS corr. factors / ДПх / **dП**
…/ PPR option / TS control / **TSx**

dP parameter for each density sensor it to be set to zero (fabrication setting). Control temperature sensor/temperature sensor x parameters is to be set in the OFF state (fabrication setting). Correspondence of other setting items and passport data are presented in the table:

Setting item	Passport table	Passport table parameter	Unit
"LS mass"	3.5	"LS / mass"	g
"LS area"	3.5	"LS / section area"	sm^2
"DS mass"	3.5	"DS / mass"	g
"DS area"	3.5	"DS / section area"	sm^2
"Density"	3.5	"Sample 1 / Density"	kg/m^3
"Level difference "	3.5	"Sample 1 / Level differences"	mm
"Area range "	3.4	"Product density measurement range"	kg/m^3
"Level range "	3.2	"Product level measurement range"	mm
"Process deviation "	3.2	"Setting constants"	mm

6.2.2 For DD group the channel is set in line with items:

…/**XX channel/Connection (PrS group)/PrS x (ON)**

PrSx - selection PrS 1...9. At the same time PrS1 is always OFF, PrS2…PrS9 depend on the group set.

6.3 Adjustment in the setting mode

6.3.1 Tank characteristics

Tank type is determined as "vertical" or "horizontal cylindrical". It is necessary to determine the tank diameter for "horizontal cylindrical" type.

The temperature factor value of tanks walls expansion (taken from the tank specification) multiplied by 10^6 is put into the item "exp. factor*1000000" is being entered. The factory setting is 12.5.

Setting items:

/Adjustment mode / Tanks/ XX tank /Tank type
… / Reserve type/ **Diameter expansion factor*1000000**

6.3.2 Liquid characteristics
Adjustment items:

/Adjustment mode/Tanks / XX tank / **Product**
/Adjustment mode/Tanks / XX tank / Product/ **Density 20**
/Setting mode/tanks / XX tank / Product / **/Component percent**

"Product" item state is selected from the list below:

Item "Product" state	Preset sample value, item state		Comments
	"Density 20", kg/m^3	"Component percent", %	
Benzene with octane number 80	705	–	Benzene with octane number 80, A-76
Benzene with octane number 92	746	–	Benzene with octane number 92, benzene with octane number 93
Benzene with octane number 95	746	–	Benzene with octane number 95
Benzene with octane number 98	746	–	Benzene with octane number 98
DO	833	–	Diesel Oil
Gas	–	33,7	Propane-butane
Water	1000	–	
Tosol	1050	–	
Cerosene	792	–	
Oil	895	–	
Sampling	705	–	

The option "Sampling" is selected for product types absent in the list.

For petroleum products in item "Density 20" the value oa product density is specified standardized for 20°C (factory setting corresponds to the average mean value for the given product type).

For types "water", "tosol", "Sampling" in item "Density 20" the density of sample is entered without standartization.

For "gas" type in item "component percent" the mass content of propane in percentage is entered.

Data on product type and density sample are used if the density meters are absent in the PPR set, if the density meters are not correct or non-operational (exit from the working mode).

If the product level goes lower than acceptable i.e. minimum for normal density meter operation ("surface" or the lowest "submerging") in the process of density measurement the measured density of the standard value is memorized and its standartized value is automatically written in the configuration item "Density 20" (for LHG the mass propane content in percentage is memorized and is automatically written in the configuration item "content percent").

6.4 Input of the gauge tank tables

Input is done in line with the КШИОЕ.421451.001И1 instruction.

7 Gauging Mode

The following setting is proposed for the measuring system channel transfer [(see figure 5.2a)]:

Configuration mode/XX channel/PPR option (graduation)

The density float DS of the "surface" density meter is to be removed from the PPR pipe. In the measuring mode the level setting parameters, volume and average temperature are to be suplemented by the non-correctness sign " # ", the density measurements are turned OFF. The level values correspond to the distance from the lowest LS case part (level float) to the PPR basis.

8 Control Functions in the System

8.1 Control algorithms

The system does the follow-up of the measured parameters state and if necessary announces the user about activities in the measurement area and/or operates the outer devices.

The operating scale of the parameter values is split into:

- average ("standard") of the standards scale;
- upper and lower ("alarm") scales;
- threshold values, determing the limits between "standard" and "alarm" scales.

Control of parameters is possible on algorithms "Maximum/minimum", "deviation", "Acceptance".

"Maximum/minimum" algorythm is convenient for tracing the parameter, values of which may change in the whole operating scale in the operational process. Example: level changes of the PP in the PS operating tank.

"Deviation" algorithm is determined for tracing the parameter for which it is acceptable to have a fixed value with a little tolerance for deviation. Example: level PP changes in the PS tank put into storage.

"Acceptance" algorithm is used for liquid loading into the tank. "Acceptance" algorythm is the extension of the "maximum/minimum" algorythm for "level" parameter. The speed of level value increase is additionally controlled.

8.2 Alarms means

From the point of view of the system the alarm means are treated as the conditional **objects.** The object characteristics allow to connect it with actual activities.

The object characteristics: object type, type of reject of the active state, CM channel parameters.

Possible object types:

a.) "Signal console" – alarm by means of IU;

b) "Pump" - CM channel control with a negative diagram (see figure 8.1);

c) "Light alarm", "horn" – CM control channels with a positive diagram.

Alarm object may locate in the active and passive states. In the active state the object is installed at switch of the controlled limits parameter between "standard" and "alarm" value scales. The "Reject" characteristics determine how the object returns into the passive state:

a) "Manual reject" – by pushing any button at the keyboard in response to a message;

b) "Time" – automatically by a setting time (0…31 s);

c) "Auto" – automatically at return of the controlled parameter into the "standard" scale.

Object of "console signal" type has a default "Manual reject" property.

Object of "pump", "light alarm" or "horn" is to be connected with an individual line of CM, to which the corresponding equipment is connected. The connection is done through the "Section number" and "line number" properties. "Line number" corresponds to a consequence number of CM in the system content. "Line number" – consequent number of the CM line.

In alarm situations (please refer to item 8.5) the object of "pump" type is being put into an active state i.e. the corresponding CM line is turned OFF. The exit from an active state is done in line with "Reject" property.

Nota Bene!

The pump shutdown is done with saving of the system logistics on control (ON/OFF) in the user's circuits area.

8.3 Control Channel

The control algorithm of the measured parameter and alarm objects are characterized by a control channel. The alarm scheme of the control channel may contain up to five objects. The objects content is optional. Each alarm object has an individual setting of "standard" and "alarm" scales of the controlled parameter values. The cyclograms of the channels operation are shown at figure 8.1.

8.4 Setting of Control Functions

8.4.1 In the setting mode the control algorithms for needed CU channel parameter and a list of used alarm objects are being set.

8.4.2 The setting of control channels

Please see a block diagram at figure 5.3. For selected (XX) channel of CU turn ON "Control" option.

Setting mode/Control/ **XX control (ON)**

Далее для выбранного параметра устанавливается нужный алгоритм контроля, настраиваются объекты сигнализации.

Then set the needed control algorithm and the alarm objects for selected parameter.

8.4.2.1 The setting of "Maximum/minimum" algorithm

Select "Maximum/minimum" algorithm for a parameter (for example, level)

…/ XX Control / **Level (Max/Min)**

Turn ON the needed alarm objects (ZZ = 1…5 consequent object number). The object type is being determined at the same time.

…/ XX Control / Level (Maximum/Minimum) / **ZZ object (type)**

Enter values for the limits between "standard" and "alarm" parameter values for each allowed object.

…/ ZZ object / Limits/ **Lower limit, Upper limit**

Determine properties for objects of "Pump", "light alarm" and "horn" type. For the selected option of "Time" reject in the field "Hold" put the duration of the active state in seconds.

…/ZZ object/Properties/**Reject, [Hold], Section number, Line number**

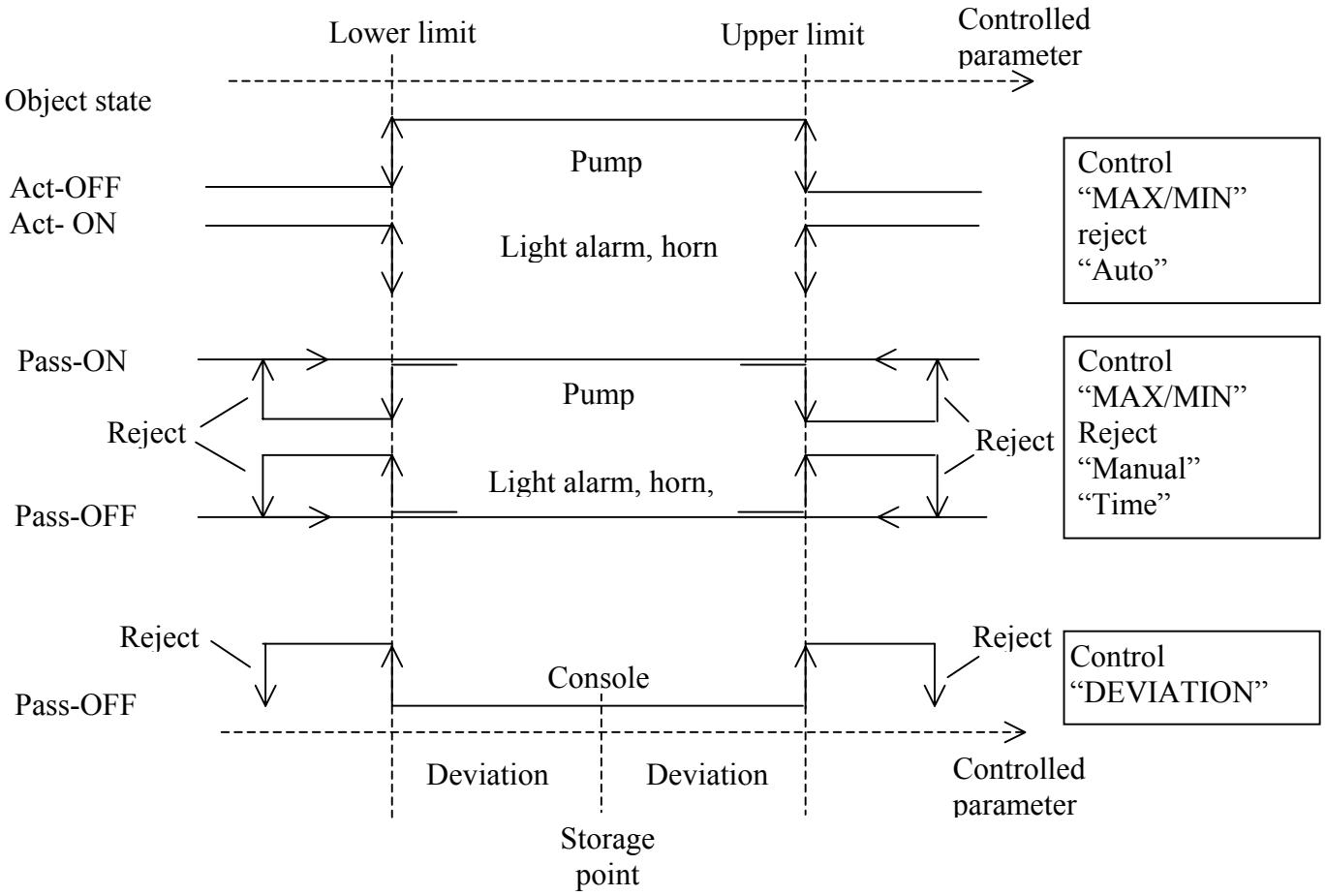


Figure 8.1

The setting is similar for "temperature" parameter.

The setting for "water" parameter:

- for PPR options equipped with AWL, alarm objects do not have the limits setting (default "standard" range – no water, default "alarm" range – water);
- for PPR options equipped with WLS the setting is similar to the "Level" parameter.

8.4.2.2 The "Deviation" algorithm setting

The setting of **"deviation"** algorithm is needed for determing the tolerance value of the parameter from the storage point ("Range") in parameter measuring units and to set the point of storage. When in the item "Save?" of the "Yes" state the current parameter state is being memorized as a point of storage. Choose "No" state for the setting that is done repetedly and it is not required to change the storage point.

…/ XX Control/**Level (Deviation)**
…/ Level (Tolerance)/Scale, Save?

The setting is similar for "temperature" and "water" parameters.

8.4.2.3 The "Acceptance" algorithm setting

Select and set "Maximum/minimum" algorithm as shown above.

Set the minimum allowable speed of product loading into a tank – the value of the minimum allowable increase of the product level in mm for the control period of pouring time $T_{load.\ contr.}$ = 25 secounds.

Setting item:

Setting mode/Tanks/XX tank/**Loading**

8.5 Control in the measuring mode

8.5.1 Messages

Messages are accompanied by a sound signal and are to be confirmed by an operator. The message is being removed by pushing any button at keyboard.

Messages types:

a) are transmitted by objects that are not correctly adjusted in the standard value range of the controlled parameter: upper limit is less or equal to the lower limit. Range control on the object is being blocked till the limits are being reset. Message example:

```
01 /Level
Pump – E90
```

b) is transmitted by "console" type object at the parameter exit from the standard value range. The controlled parameter display is compulsory set and the sound signal is transmitted;

c) is transmitted by an object of "Pump", "light alarm" or "horn" type that have a "Manual reject" property at the parameter exit from the standard value scale. Messages example:

```
01 Level
Pump OFF
```

d) error of the measuring parameter at the active control function. The message is created if any control algorithm for the parameter is activated and the parameter is failed.

The errors codes are given in section 9. Message example:

```
01 Level
Control E-6
```

At the adjustment works or in case of mass parameters failure set to control there may be given up to 48 messages in a row of "Control E-..." type. The message flow may be turned OFF by pushing 'EX' button in response to a consequent message.

e) the connection error with CM n (n - consequent number of CM (section) in the system). The connection with CM is controlled only if the turned ON "Pump", "light alarm " and "horn" objects in the control channels are available. The comments to the error are given in section 9.

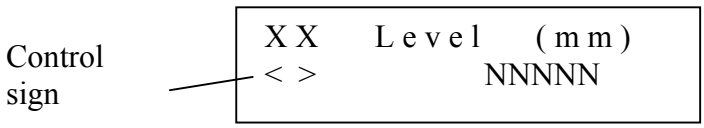
```
NO CONNECTION
WITH CM-1
```

8.5.2 Loading/unloading liquid control

The original setting:

- the system is in the measuring mode;
- for "Level" parameter" of CU XX channel the "Acceptance" algorithm the control sign as a symbol "< >" is present at the parameter display.

Example of "Level" parameter depiction:



8.5.2.1 To activate the control of **dynamic liquid leak at loading** it is necessary to push button "." (dot). Within 1-2 seconds after pushing button the control sign on the display will change to "->".

At filling the tank the level value (sign-place NNNNN) is to largen. In case if the speed of tank loading is less than the set one the following message will appear on the display:

Simultaneously with the message appearance the pump control line will be switched OFF (if the "pump" alarm object in the given control channel is available).

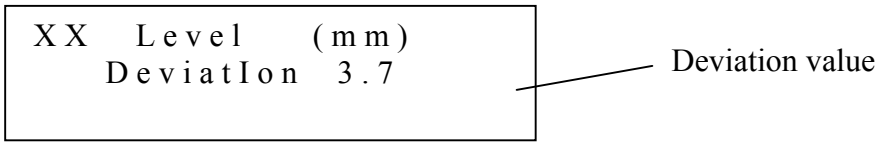
```
XX Level
   no enlargement
```

The "No enlargement" message can be taken off by pushing any button at the keyboard. Taking off of the message will lead to the restart of the control channel:

- control of the dynamic leak will restart;
- "Pump" type object will return to the passive state (pump control line will be ON).

The control of the dynamic leak is taken off by pushing "." Button (dot) repeatedly, within 1-2 seconds after pushing the button the control sign will take the initial view "< >".

If the level depiction is available by pushing "8" button during the loading process it may be possible to follow the "Acceptance" algorithm operation in the "Deviation review" window. In the beginning of the consequent loading control time period ($T_{load.\ contr.}$, refer to item 8.4.2.3) the current level value is fixed as a temporary "point of storage". The level deviation from the fixed pont is displayed within $T_{load.\ contr.}$.



The deviation value in the end of the control time period should be no less than the value set at the adjustment.

For return to the parameter value review push "8" button repeatedly.

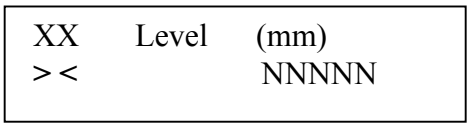
8.5.2.2 The control of **overflow and extensive drainage** is done automatically without additional operator's instructions. If the level values are beyond the "standard" scale the corresponding alarm object is being switched ON into an active state. If the property "Manual reject" for this object has been set, the unit display gives a message (for example "The pump is OFF"). By pushing any button at the keyboard the message is rejected and the object is switched to the passive state.

8.5.3 The control of the static liquid leak

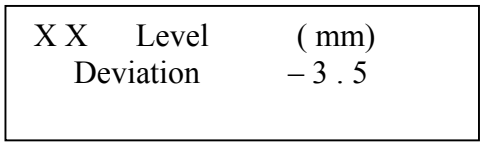
Initial state:

- the system is in the measuring mode;
- for "level" parameter of the measuring channel XX the "Deviation" algorithm is active, the control sign "> <" is visualized on the display.

Example of Level parameter depiction:



If the parameter value differs from the "point of storage" on the number equal to the setting "Scale" (figure 5.3b), dialog box "Deviation"), the system sets the depiction type "Deviation review" for the parameter. The depiction is accompanied by the faltering horn signal.



In this case the current value is 3.5 mm below the point of storage. The depiction returns to the initial view after pressing any key. "Deviation" control of the parameter will be switched OFF. It is necessary to change the control setting for the parameter in order not to have the control restarted at the consequent turning on of the system.

It is possible to watch the algorithm operation in the "Deviation review" window by pressing key "8". The deviation will be calculated even with no control. If the storage point is not set its value will be zero.

8.5.4 The error measurements control

The active error measurements control is done with any parameter control algorithm. The control channel actions in case if the parameter is wrong:

- the error message is visualized at the IU display (see item 8.5.1 c);
- "Pump" type control object is switched into an active state (control line is switched OFF) till the message is confirmed;
- the control sign at the parameter depiction is taken off;
- control channel switches to the hold state till the parameter is restored.

After restoring the parameter correctness and its stable operation within 5 s the corresponding control channel will be restarted.

9 Trouble Shooting and Current Repairs

9.1 The description of the errors is given in tables 9.1…9.10. For each error the text to the IU display is visualized with the possible reasons of the error appearance and recommendations on how to fix them. If there're several possible reasons they are presented in the order of their review by the user.

The repair of the system is done by the operating laboratory of CJSC "NTF NOVINTEKH".

9.2 The methods of the diagnostical information are presented in the system

9.2.1 The power indicators are integrated into the 220 V power switches CD and CM, the secondary power supply indicators are located on the cover of PSU unit.

9.2.2 The text information displayed at the IU screen

a) trouble-shooting messages formed independently by IU unit: "No connection with CU", "Keyboard error" (see figure 9.1 a). The message is taken off automatically if the problem is eliminated;

b) information on the errors integrated in the current interface of the measurements mode is formed by the CU unit for depiction to the IU screen and for transmitting to PC. The errors description is given in tables 9.2 … 9.10.The depiction examples are presented at figures 9.1 d), 9.1 e).

c) the error messages formed by the CU unit are similar as described above for the control subsystem. The message completely replaces the current information on the IU display. The message is taken off by pressing any key of the IU keyboard. At the same time the previous display view is restored. The message depicts the system actions on-line. If several activities are simultaneous the next message appears after the operator takes off the previous one.

If «E-9» errors are indicated (see figure 9.1 b), «E-10» operator's actions are to be specified.

The errors description is presented in table 9.1. The message examples are presented at figure 9.1 c) and in item 8.5.1.

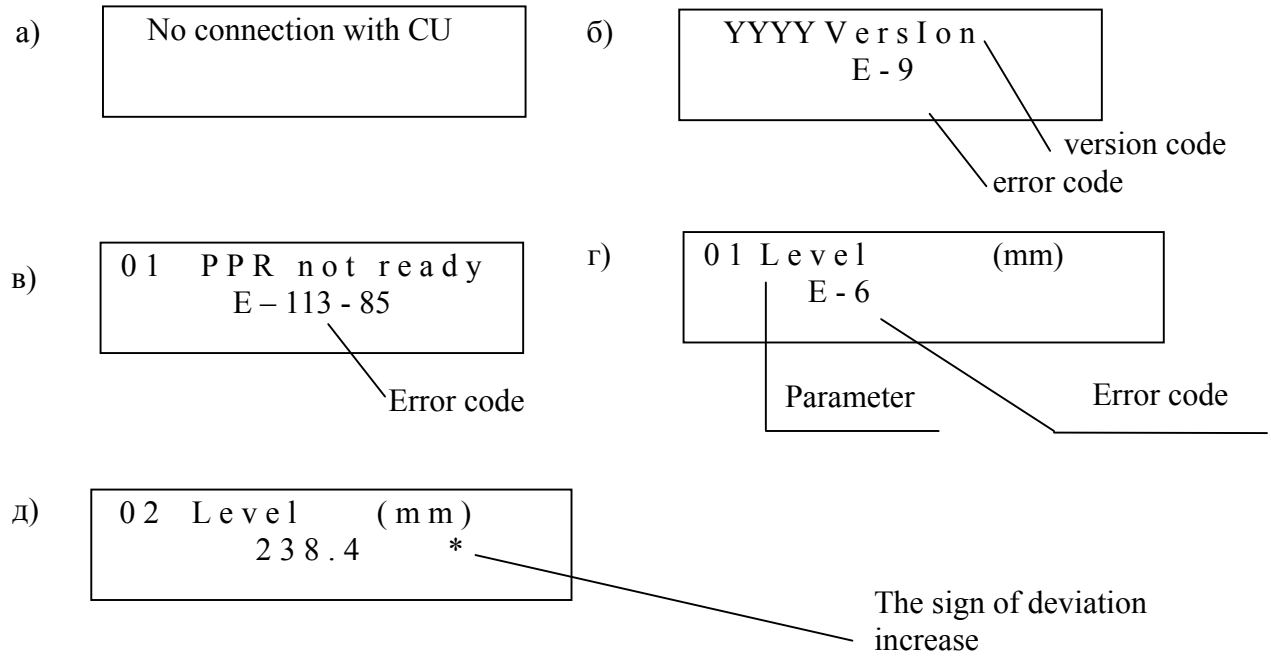


Figure 9.1

Table 9.1 – General failures

Failure indication	Failure cause	Test method	how to eliminate it
1	2	3	4
No light at IU screen and PSU «5V» and «27V» indicators	CD Power supply switch is in OFF position		Change the power supply switch into ON position
	No 220 V power supply at the CD input		Provide 220 V power supply at the CD power supply socket
	PSU fuse is out of order		Change PSU fuses (with 220 V power supply OFF)
	PSU is out of order		Repair in the operating laboratory
No light at IU display, PSU «5V» and «27V»indicators are enlightened	IU-CU is out of order (power supply circuit is broken)	Cable wholeness is tested by visual inspection and by an ohmmeter [2)]	Eliminate cable failure
	IU is out of order		IU repair in the operating laboratory
The "No connection with CU" message appears at the IU display	Failure in the CU program from electrical interference	Turn OFF and ON CD power supply. If the error is eliminated follow the recommendation on elimination of the electrical interference [1)].	
	IU-CU cable is out of order (alarm circuits are broken)	Cable wholeness of the circuit is tested by visual inspection and by an ohmmeter [2)]	Eliminate cable failure
	CU or IU is out of order		Repair in the operating laboratory
The «No connection with CM-X» is visualized at the display (X - CM number in the system in line with the marking "X section")	Power switch is OFF CM-X is OFF (no light at the integrated switch OFF indicator)		Turn the power switch of CM-X into ON position
	For CM with X>1: no power supply of CM-1		See other options.
	No 220 V power supply at the CM-X input		Provide 220 V power supply in the CM-X socket
	The CM-X network fuses are out of order		Take off the CM-X cover and replace the network fuses
	CM-CU cable(s) are out of order	Cable wholeness of the circuit is tested by visual inspection and by an ohmmeter [2)]	Eliminate the cable failure
	CM-X unit is out of order		Repair of CM-X in the operating laboratory
	CU is out of order ("Port 2") (no connection with all CMs)		Repair CU in the operating laboratory

Continuation of 9.1 table

1	2	3	4
«E-9» message is visualized on the IU display	The loss of the correct CU configuration setting after loading of the new software version not compatible with the previous one		Press "EX" key of the IU keyboard three times. Restore the configuration setting following the 6 and 8 sections of the new software version.
"E-10" is visualized at the IU display	All CU configuration channels are switched OFF		Restore the correct CUconfiguration setting
«E-1XX» message at the IU display where XX are any numbers	PPR failure (loss of configuration)		PPR repair in the operating laboratory
«Version YYYY T» message at the IU display if there's a lack in the set of the measuring system «STRUNA» program	In CU configuration the transportation mode is set for operation with the measuring system "STRUNA" program		Switch into the OFF state the CU configuration point "Additional devices/transport mode"

Table 9.2 - Channel disorders of CD connection with PPR, PrS (JB) (Indication at the IU display, diagnostic codes on the "Kedr" protocol spec. 2.0 and higher for any measuring parameter).

Failure indication			Failure cause	Test method	How to eliminate
БИ	«Kedr»				
	ERR	EPR			
«E-51» or «E-56»	51 or 56	N/A	If the error is on all the channels and PSU «27B» indicator has no light it is probably due to the PSU protection from overload	Switch CD power supply OFF and ON.	
				If PSU «27V» indicator has no light, PSU is out of order.	Repair of PSU in the operating laboratory
			Earthing circuits in the system are broken (PPR, JB, CD)		Restore the earthing system circuits [4].
			Cable failure at connection of PPR, PrS, JB and CD or inadequate connection	Test the cable wholeness by visual inspection, test the connection quality.	Eliminate failures and restore the cable connection.
				Test the cable insulation resistance and perform testing with an ohmmeter [2].	
			PPR or CU disorder	Determine the damaged unit by cross-connection of damaged and operating channels with PPR [3].	PPR or CU repair in the operating laboratory
			Interference in CU-PPR connection line		Perform the recommendations on elimination of electrical interference [1].
«E-52» or «E-53»	52 or 53	N/A	Interference in the CU-PPR connection		Perform the recommendations on elimination of the electrical interference [1]
«E-99»	99	N/A	CU-PPR connection failure in the initialization mode at reading of the PPR configuration or if PPR configuration is damaged	Switch CU power supply OFF and ON	
				If the «E-1XX» message is presented for the channel, the PPR is out of order	PPR repair in the operating laboratory

Table 9.3 – Failures at the product level measurement. (Indication at IU display for "Level" parameter", diagnostic codes in line with "Kedr" protocol spec. 2.0 and above for L parameter).

Failure indication			Failure cause	Test method	How to eliminate it
БИ	«Kedr»				
	ERR	EPR			
1	2	3	4	5	6
«E-50»	50	N/A	The "Typical with density"PPR option has been chosen in CU configuration for the channel and PPR is connected without a density meter		Install into CU configuration PPR type in line with system specification
			The density or level float is absent at PPR with surface density meter	Remove PPR from a tank and check the availability of floats	Install the missing floats on PPR and check the correctness of floats constants inputs into CU configuration.
			Earthing circuit defect in the system (PPR, CD)		Restore earthing circuits [4)].
			Interference in the CU-PPR connection line		Perform the recommendations on electrical interference elimination [1)].
			PPR disorder		PPR repair in the operating laboratory
«S»	0	71	The constants of the float system in the CU configuration are not entered correctly		Restore the correct setting of CU configuration
«*»	0	72	Temperature measurement error		See table 9.5
«P»	0	73	Density measurement error		See table 9.4
«L», «E-74»	0	74	The upper limit of the measuring scale in the CU configuration is not set correctly		Restore the correct setting of the CU configuration setting
			The product level exceeded the upper scale limit		Change the product level in the tank
«L» , «E-75»	0	75	The lower measurement limit in the CU configuration is not set correctly.		Restore the right CU configuration setting.
			The product level became below the lower limit of the measurement scale		
«#»	0	80	The "Graduation" PPR option is chosen for the channel in the CU configuration		Restore the correct setting of CU configuration.

Table 9.4 – The failures at density measurement (Indixation at the IU display for parameter "ar. density N". Diagnostic codes on "Kedr" protocol (spec. 2.0 and above) for [N] parameter.

Failure indication			Failure cause	Test method	How to eliminate
БИ	«Kedr»				
	ERR	EPR			
«E-50»	50	N/A	See table 9.3 for «E-50»		
			Measuring density unit (MDU) in PPR with "submerged" density meter is not connected to controller	Visually check the connection of plug-type MDU cable connection to PPR controller	Connect plug-type MDU cable connection to PPR controller
			Density float is absent at MDU pipe or is installed incorrectly	Remove MDU from a tank. Check the availability and correctness of density floats installation.	Restore the correct MDU assembly
«*»	0	72	Temperature measurement error		See table 9.5
«P»	0	73	The product density doesn't correspond to the density measurement scale	Take a sample from a tank, measure its density and compare to the specified measurement range	Change product in the tank in line with the passport system data.
					Replace the density meter, please contact the operating laboratory
			The incorrect range is entered in the CU configuration		Restore the correct CU configuration setting.
«L»	0	78	The product level for the "submerged" density meter is lower than for the acceptable		
From «E-91» to «E-94»	From 91 to 94	N/A	The system constants of CU configuration are set incorrectly for "surface" density meter		Restore the correct CU configuration setting

Table 9.5 – Failures in temperature measurement. (Indication at the IU display for "Temp. N" parameter. Diagnostic codes for "Kedr" protocol (spec. 2.0 and above) for T [N] parameter)

Failure indication			Failure cause	Testing method	How to eliminate it
БИ	«Kedr				
	ERR	EPR			
«E-2»	2	N/A	TS failure		PPR repair in the operating laboratory
«E-7»	7	N/A	TS is turned OFF in the CU configuration		PPR repair in the operating laboratory with the consequent turning ON of TS in the CU configuration.
«*»	0	72	TS is not graduated		PPR repair in the operating laboratory
TS testing shows that the allowable tolerance limit is not exceeded, no messages on display			TS metrological failure	In line with the channel temperature measuring testing, or in the difference of the registration of the TS concerning other sensors (to 5°C and above)	PPR repair in the operating laboratory
					Turn OFF the TS in the CU configuration (at the same time the system characteristics may worsen)

Table 9.6 – Failures in the bottom water measurement mode for PPR with WLS (Indication at the IU display for "Water" parameter: diagnostic codes in line with "Kedr" protocol (spec. 2.0 and above) for Hw parameter)

Failure description			Failure cause	Test method	How to eliminate it
БИ	«Kedr»				
	ERR	EPR			
«E-50»	50	N/A	WLS failure		PPR repair in the operating laboratory
«P»	0	73	Density parameter failure		See table 9.4
«H»	0	76	WLS float is located near the upper limit ring, the bottom water level is beyond the measurement range		
		77	WLS float is located near the lower limit ring, the bottom water level is beyond the measurement range		

Table 9.7 – Failures in the bottom water level measurement mode for PPR with AWL (Indication at IU display for "Water" parameter. Diagnostic codes for "Kedr" protocol (spec. 2.0 and above) for Hw parameter)

Failure indication			Failure cause	Testing method	How to eliminate it
IU	«Kedr»				
	ERR	EPR			
«E-2»	2	N/A	PPR failure		Repair of PPR in the operating laboratory
«E-3»	3				

Table 9.8 – Failures in the pressure measurement mode (Indication at the IU display for parameter "Pressure N". Diagnostic codes for "Kedr" protocol (spec. 2.0 and above) for Q [N] parameter.

Failure indication			Failure cause	Test method	How to eliminate it
IU	«Kedr»				
	ERR	EPR			
«E-2» or «E-3»	2 or 3	N/A	CU-PrS has small section of fibers	Check the cable fibers section that is to be no less than 0.35 mm^2	Replace cable for recommended МКЭШ 5×0,35
			PrS failure		Repair of PrS in the operating laboratory

Table 9.9 - Average temperature parameter errors (Indication at the IU display for "Av. temp." Diagnostic codes for "Kedr" protocol (spec. 2.0 and above) for T parameter.

Failure indication			Failure cause	Test method	How to eliminate it
IU	«Kedr»				
	ERR	EPR			
«E-6»	6	N/A	No operational PrS		Repair PPR in the operating laboratory
			Product level parameter error		See table 9.3
«*»	0	72	No operational PrS in the product area		Repair PPR in the operating laboratory

Table 9.10 – Average density parameter error (Indicaton at the IU display for "Av. Density" parameter. Diagnostic codes for "Kedr" protocol (spec. 2.0 and above) for P parameter).

Failure indication			Failure cause	Test method	How to eliminate it
БИ	«Kedr»				
	ERR	EPR			
«*»	0	72	Temperature parameter error See table 9.4.		
«P»	0	73	No operational density meters. See table 9.5.		
«L»	0	78	Product level is below the acceptable for all density meters		

Comments

1 Recommendations on electrical interference elimination.

Remove the communication cable from the network cables at the distance of no less than 1 m, check the working condition of the surrounding equipment and earthing circuits.

2 Cable schemes are given in the Installation Manual КШЮЕ.421451.001ИМ. For CU-PPR (PrS) cables the resistance of the circuit insulation concerning the display should be no less tham 1Mohm.

3 The methods of detecting the failed component of the PPR, TS connection channel.

The X channel (channel X=input (CU) X +cable (CU-PPR) X + PPR X) has signs of disorder and the Y operating channel with PPR in both channels of the same type.

Turn On the CU X cable to Y outlet, switch Y cable to X inlet.

If error in the X channel indications is remained, the X outlet is damaged.

If the error disappears in the X channel indications and appears at the Y channel indications, the X cable –PPR X combination is under suspection. As the cable is already checked, the PPR X is out of order.

Return the cable connection to their inlets.

4 Earthing

Check the wholeness of the earthing circuits by visual inspection. Check the earthing circuits resistance that should not exceed 4 Ohm.

Appendix A
(mandatory)

The methods of level measurement channel scale deviation (with reference to a tank).

The necessity of the level sensing channel (LSC) scale deviation of the system for the tank may be caused by:

a) non-compliance of the level measuring point in the system with level measuring point determined for the tank graduation table that leads to the impossibility of the correct estimation of the volume and product mass system;

b) installation of PPR in the point non-compliant with the level measuring point for the tank;

c) tank bottom deformation within the operating process that causes problems indicated in items a) and b).

Follow these steps for the LSC deviation:

- determine the needed value of the LSC scale deviation **ΔL on** the basis of the static data analysis of the gauging by the gauging rope or other measuring means (**ΔL** may be a negative or positive value);
- change the **ΔL** value of the parameter indication **"Deviation (mm)"** in the setting item:

Setting mode/tanks/XX tank/deviation/**deviation (mm).**

Nota Bene!

1 The LSC scale deviation changes the working range of the product level measurements. The level indications beyond the working range are not acurate.

Lmin = **L**min.pasp. + **ΔL**

Lmax = **L**max.pasp. + **ΔL ,**

where Lmin.pasp., **L**max.pasp. are level measurement limits values from system specification КШЮЕ.421451.001ПС.

2 Threshold level values for the control system are to satisfy the condition:

Lмин < **L**порог < **L**макс

$L_{min} < L_{threshold} < L_{max}$

3 The estimation of the product volume is done on the basis of the supposition that the LSC scale is given from the beginning of the level coordinates of the graduation tank table.

4 Alarm on the bottom water level doesn't depend on the deviation of the LSC scale and is done referring to the PPR base.

5 The deviation of the LSC scale changes the working measurement level range of the bottom water. The level sensor indications beyond the working range are not correct.

Lвmin = **L**вmin.pasp. + **ΔL**

Lвmax = **L**вmax.pasp. + **ΔL,**

where **L**вmin.pasp., **L**вmax. pasp. are the values of the level measurement range of the bottom water for КШЮЕ.421451.001ПС passport.

Appendix B
(mandatory)

The methods of adjustment the density measurement channel

Nota Bene! The adjustment is to be done not earlier that within 2 hours after the system installation of PP acceptance at PP temperature from minus 20°C to +45°C. The maximum adjustment accuracy is provided at PP temperature in the tank 20±10°C.

The adjustment process consists of two stages:

– accuracy of density measurement control;
– factor input.

The recommended frequency of the accuracy control is once every six months.

B.1 The accuracy measurement density control by the system by means of the areometer.

B.1.1 Put an aerometer into the tank, take a sample PP from the level of the adjusted density meter location, pour in the package and tightly close the package cover.

B.1.2 Determine the density of the PP sample with an areometer at standard temperature 15°C ($\rho_{15)}$ or 20°C (ρ_{20}) in the laboratory conditions in line with the following methods.

B.1.2.1 By holding change the temperature of the light PP (petroleum, kerosene, diesel oil) in the closed package, areometer, glass cylinder and thermometer till the environmental temperature 20±10°C.

Follow GOST 51069-97 for other PP.

B.1.2.2 Pour the PP sample into a clean glass cylinder and remove the appeared air bubbles with clean filter paper.

Б.1.2.3 Put the cylinder with PP sample in the vertical position in the place protected from the wind (draughts) and convenient for reading out the indications of the areometer scale.

Nota Bene! Within the holding period of the sample density of PP the environmental temperature should not change to more than 2°C.

B.1.2.4 Accurately put the areometer into the PP sample

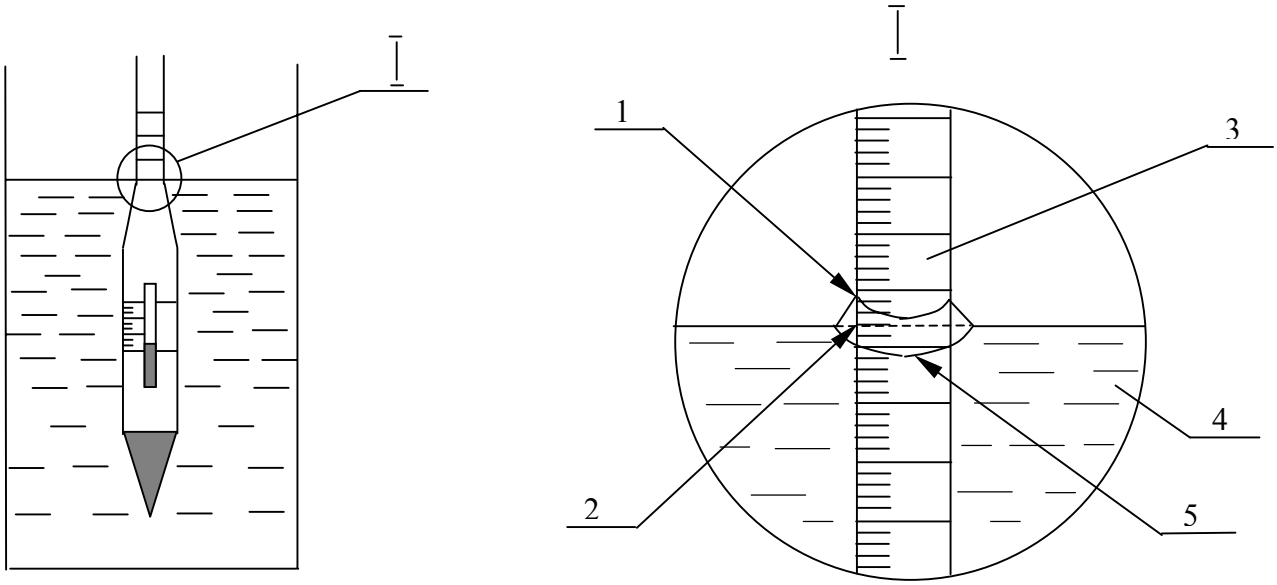
Nota Bene! Soaking of the aerometer bar above the immersion level is not acceptable. In case if the areometer gets wet take it off the PP sample, wipe with a clean and dry napkin and repeat the immersion.

B.1.2.5 Put the thermometer in the PP sample and mix it with the thermometer continuously so that the mercury column is completely immersed into water, and the areometer bar above the immersion level is not wet. As the stable temperature is achieved register it with 0,1°C accuracy and then remove the thermometer.

B.1.2.6 When areometer is in the quiet state and floats at the equal distance from the tank walls, read the indication from the areometer scale with the accuracy of 1/2 calibration mark. The correct value of the areometer is the point at the areometer scale where the liquid surface separates this scale. This point is determined by looking a little bit lower the liquid level and by slowly rising the eyesight till the liquid surface separates the scale (see figure B.1).

B.1.2.7 When determing the density of the dark PP it is necessary to read out the value in the upper part of the meniscus (see figure B.1) and to make a tolerance factor +0.7 kg/m^3 to the indication of the areometer scale.

B.1.2.8 Right after reading out the value at the areometer scale put the PP thermometer in the sample and mix the sample by the PP thermometer so that the mercury column will be completely immersed into the PP sample. Register the PP sample temperature with 0.1 °C accuracy. If this temperature differs from the previous value to more than 0.5°C, make the value density determination by an areometer once again and take the thermometer values till the temperature becomes stable with 0.5°C accuracy.



1 –point of values registration for dark PP;
2 –point of values registration for bright PP;
3 –areometer bar;
4 –PP sample;
5 –meniscus basement

Figure B.1 – areometer scale value

B.1.2.9 Determine the ρ_{15} or ρ_{20} value in line with МИ 2632-2001 method. It is acceptable to determine ρ_{20} value in line with the GOST 3900-85 tables at PP temperature 20±10°C.

B.1.3 Take the density value "Dens.-15" and "Dens.-20" in kg/m^3 in the measuring mode .

B.1.4 Estimate the density value accuracy in line with formulas:

$$\Delta\Pi = \text{“Dens-15”} - \rho_{15} \quad \text{(B.1)}$$

$$\text{or } \Delta\Pi = \text{“Dens-20”} - \rho_{20}, \quad \text{(B.2)}$$

where: "Dens-15" ("Dens-20") – density value of PP sample at standard temperature 15°C (20°C), received with the system, kg/m^3;

ρ_{15} (ρ_{20}) – the PP sample density sample at standard temperature of 15°C (20°C), received with an areometer, kg/m^3.

The density measurement accuracy control when the mobile automatic density meter is used.

B.2.1 Measure the PP density at the level of adjusting density meter location with the mobile automatic density meter in line with the operator's manual.

B.2.2 Take values "Density-Areometer" in kg/m3 in the measuring mode from the IU display.

B.2.3 Estimate the accuracy of density measurement of the system according to the formula:

$$\Delta\Pi = \text{“Dens.-AR”} - \text{dens.gen.}, \quad \text{(B.3)}$$

where: "Dens.-AR"– density value of PP, received with the system, kg/m^3;

Dens. Gen. – value of PP density at the adjustable density meter received by the mobile automatic density meter, kg/m^3;

B.3 Correction factors

B.3.1 If ΔП is beyond the limits of the acceptable measurements accuracy of the density of the adjustable density meter the correction factors are to be obligatory taken into account, and if it is beyond the accuracy it is recommended to have a correction factor but to take into account that after the correction factor is being accepted it is necessary to do the out-of-sequence check of the adjustable density meter.

Enter «dП» item of the system setting and read previously set value of the factor ($d\Pi_{set}$):

Configuration mode/XX channel/(PPR) connection/PPR option/ DS/DS Y/**dП** correction factors

Where Y – adjustable density meter number in PPR (count from the tank bottom).

Estimate the new correction factor value ($d\Pi_{new}$):

$$d\Pi_{new} = d\Pi_{set} + \Delta\Pi \qquad (B.4)$$

B.3.4 Put the new correction factor value in the system. The input sequence is given in table B.1

Table B.1 – The factors in the system configuration

Setting step	Pres button at IU	Depiction at the IU display	Density meter type
1	2	3	4
Input into configuration mode	«EX»	Enter password _	Any
Password entrance	«0»… «9» (5 digitals)	Enter password □□□□□	Any
Transmittal to item «XX channel»	«+»	01 channel △ ON ▷	Any
Channel number selection (XX – channel number)	«9» – enlarge «6» – shrink	XX channel △ ON ▷	Any
Transmittal to item «Connection»	«+»	PPR Connection ▷	Any
Transmittal to item «PPR option»	«+»	PPR option △ typical with density meter ▷	«Surface»
		PPR option △ Long mearument ▷	«Immersion»
Transmittal to dialog «Typical with density meter»	«+»	LS △ ▷	«Surface»
Transmittal to dialog «Long measurement»		Level range △ ▷	«Immersion»
Transmittal to item «ДП correction factors»	Several times «9» or «6»	DS correction factors △ ▷	Any
Transmittal to item «ДПХ» (X – density meter number)	«+»	DS1 ▷	«Surface»
		DS1 △ ▷	«Immersion»
Density meter number selection (X – density meter number)	«9» – enlarge «6» – shrink	DSX △ ▷	«Immersion»

Continuation of B.1 table

1	2	3	4
Transmittal to item «dП» (X,X – dП value)	«+»	dП (kg/m^3) x, x	Any
Registration accept dП	«EX»	dП (кг/м^3) x, x _	Any
Value input dП (i.e. dП =1,2kg/m^3)	«0»… «9», «•»	dП (кг/м^3) 1,2_	Any
Return to item «ДПХ» (X – density meter number)	«+»	DS1 ▷	«Surface»
		DSX △ ▷	«Immersion»
Transmittal to item «DS correction factors»	«0»	DS correction factors △ ▷	Any
Transmittal to item «PPR option»	«0»	PPR option Typical with density meter △ ▷	«Surface»
		PPR option Long △ ▷	«Immersion»
Transmittal to item «Connection»	«0»	PPR connection ▷	Any
Transmittal to item «XX channel»	«0»	XX channel ON △ ▷	Any
Request for exit from the configuration mode	«0»	Exit? ▷	Any
Return to mode «Measurement» (XXXX – number of software version YYYY – level)	«0»	XXXX version	Any
		In a few secounds:	
		0 1 level (mm) YYYY	

B.3.5 Check the correctness of correction factors:

a) if the accuracy is controlled by an areometer repeat items Б.1.3 and B.1.4. If ΔП value is within the limits ±0,3 kg/m^3, the correction factor is done correctly otherwise repeat items B.1.3, B.1.4, B.3.2 … B.3.4;

b) if the accuracy is controlled automatically by a density meter repeat items B.2.2 and B.2.3. If the ΔП is within the limit ±0,3 kg/m^3, the correction factor is done correctly otherwise repeat items B.2.2, B.2.3, B.3.2 … B.3.4.

B.4 Adjust the other density meters for the media.

B.5 Register an adjustment in the system specification.

B.6 List of measuring means and adjustment equipment is given in table B.2.

Table B.2

Name	Main characteristics	Type, GOST	Quantity
1 Set of areometers	Value of division 0,5 kg/m^3	ANT-1 GOST18481-81	1
2 Density meter	The limits of the acceptable absolute measuring density ±0,5 kg/m^3	DM-230 LEM-K100.000.00ТУ AO "LEMIS BALTIC", Latvia	1
3 Set of thermometers	Value of division 0,1°C. The limits of the absolute measurement accuracy no more than ±0,2°C	TL-4 TU25-2021.003-88	1
4 Sample intake	Volume 850ml	GOST 2517-85	1
5 Glass cylinder	Height 520mm	Cylinder-1 45/520 GOST 18481-81	1
6 Package for sample carrying	Package material resistant to PP, tight cover	–	1

Comments

1 It is acceptable to use other density meters except for DM 230that provide the density measurement accuracy no less than ±0,5kg/m^3 as mobile automatic density meters.

2 It is recommended to use the standard areometers with the acceptable accuracy measurements limits ±0,1kg/m^3 for the higher adjustment accuracy.

Appendix C

(for information)

List of reference documents

Name	Title	Items
КШЮЕ.421451.001ПС	MEASURING SYSTEM "STRUNA". Passport.	4.5; 4.6; 4.8; 6; Appendix A
КШЮЕ.421451.001И1	MEASURING SYSTEM "STRUNA". Tanks graduation tables instruction.	6.4
КШЮЕ.421451.001РЭ	MEASURING SYSTEM "STRUNA". Operator's Manual.	4.6
GOST 51069-97	Petroleum and Petroleum products. Method of determination the density, specific gravity and gravity in degrees by API areometer.	Appendix B B.2.1
GOST 3900-85	Petroleum and petroleum products. Method of gravity determination.	Appendix B B.2.9
МИ 2632-2001	GSI. Petroleum and petroleum products and coefficiencies of extension and compressibility. Methods and program for estimation.	Appendix B B.2.9