Data collection and transmission device USPD PUMA 30.04.01.LoRaWAN

USER MANUAL

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1. Purpose

USPD PUMA 30.04.01.LoRaWAN (hereinafter referred to as the device) is designed for the construction of automated information and measurement systems for resource accounting, as well as for the construction of systems for monitoring, dispatching, condition control and control of equipment modes at a remote facility.

The following types of devices can be connected to the USPD:

- pulse flow meters, counters;
- leak sensors;
- temperature sensors;
- alarm signals from external devices;
- metering devices with RS485.

List of supported counters:

- Mercury 203
- Mercury 230
- Mercury 234
- AIST A100
- AIST A300

The device provides data reading from external devices, with subsequent data transmission via a wireless LoRaWan network.

The device can be used:

- V composition automated information-measuring systemscommercial accounting of resources;
- as part of monitoring and dispatching systems;
- as part of the Smart City projects;
- as part of IoT (Internet of Things) projects.

2. Appearance and description of the device

The device is housed in a durable plastic case. Inside the case is a circuit board with a microcontroller, a memory device, an RS485 interface unit, a pulse output data readout circuit, a 1-wire support circuit, and a LoRaWAN modem.

The battery is installed in the holder. Battery replacement is possible without the need for soldering.

The exterior of the housing features sealed entries for connecting the interface cable, external sensor wires, and antenna. LED indicators indicate the device's status.

The device's housing is flanged and can be mounted on a panel. It is equipped with a sealing gasket and has an IP65 protection rating. The device's appearance is shown in Figure 1.

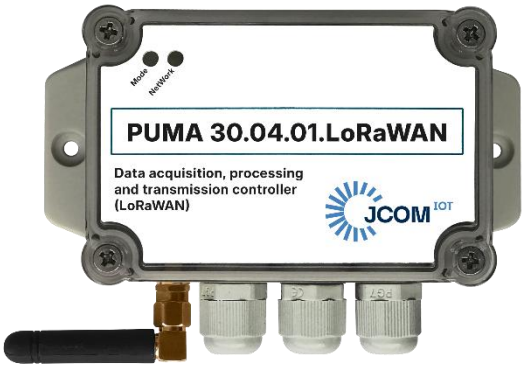

Fig. 1 – USPD PUMA 30.04.01.LoRaWAN

3. Technical specifications

The technical characteristics of the device are given in Table 1.

Table 1. Technical characteristics of the PUMA 30.04.01.LoRaWAN data transmission unit

Name characteristics	Meaning
Device modification	**PUMA 30.04.01. LoRaWAN**
Power specifications	Built-in lithium battery with a nominal voltage of 3.6 V, chemical composition: Li, SOCl2, battery size A, capacity 3.5 Ah, standard terminals Continuous discharge current (max): 1A, Pulse discharge current (max): 2A Pipe: -55...85 °C, Size 18.5x18.5x50.5mm **Battery type - ER18505M/T (FANSO)**
Operating frequencies, MHz	864-865; 868.7-869.2 (according to the decision of the State Commission on Radio Frequencies) User reconfiguration is possible.
Output power	No more than 25 MW (according to the decision of the State Commission on Radio Frequencies)
Modulation type	LoRa
LoRaWAN specification compliance 1.0.2	+
Device class	Class A (according to LoRaWAN specification)
Width stripesc hannel bandwidth	125 kHz
Speed transmissi onsdata	0.3-50 kbps
Maximum sizepac kage (including servicedata) ,	50 bytes
Maximum communication range:	- in urban areas - up to 1.5 km - in line of sight - up to 15 km
Indication (LEDs)	- Mode - the operating mode of the device - Network - network status

Name characteristics	Meaning	
Custom interface for configuration	RS485	
Interface for connecting external devices	RS485	
Protocols	COAP, MQTT	
Encryption transmitted data	DTLS-PSK	
Lid opening sensor	There is	
Number of independent entrances	5	
Input types	**Input 1, Input 2 (pulse, security).** Configured to one of the types: - to count pulses from a connected device - Detection of the connected sensor's activation. Typical applications: - metering devices with pulse output (water meters, gas meters, flow meters). - Water leak sensors, motion sensors, security sensors, opening sensors. **Input 3, Input 4 (pulse, security, Namur).** Configured to one of the types: - to count pulses from a connected device - recording the activation of the connected sensor. - for counting pulses from a Namur standard device Typical applications: - metering devices with pulse output (water meters, gas meters, flow meters). - Water leak sensors, motion sensors, security sensors, opening sensors. - Meters with pulse output (water meters, gas meters) supporting the NAMUR standard, with recognition of open or short circuit in lines. **Entrance 5**- connection of an external temperature sensor with a 1-wire interface	
Built-in magnetic sensor	+	
Built-in accelerometer	+	
Antenna	External magnetic base, with cable (3 m)	
Maximum length cables to sensors	RS485	no more than 200 m
	Namur	no more than 3 m
	Pulse input from counters	no more than 3 m
	Discrete input	reed switch type for security sensors - no more 20 m

Name characteristics	Meaning
Frame	Plastic (polycarbonate)
Installation	To the panel
Degree of protection	IP65
Cable entries	PG 7 cable glands
Connector type	Push-in terminal blocks for connecting external devices, SMA for antenna connection.
Operating range temperatures	-40 to + 70°C
Overall dimensions	No more than 145x90x55 mm (including flanges and cable glands)
Weight, no more than	0.3 kg
Service life	20 years (excluding battery)

4. Configuring the device

4.1 List of configurable device parameters

Table 2 – Factory settings of the device (default)

Parameter	Factory settings
General settings	
RS485 interface parameters	115200-8-1-None
Selecting a frequency plan	+
Authorization mode	OTAA
Maximum packet size (including service data)	50 bytes
Data transfer period to the server, min	1440
Data sampling period, min	60
Login Settings1	
Input type (sensor or pulse input)	pulsed
Serial number of the connected meter	Not installed
Initial reading (m3) upon commissioning	Not installed
Volume (m3) per 1 pulse	0.001
Login Settings2	
Input type (sensor or pulse input)	pulsed
Serial number of the connected meter	Not installed
Initial reading (m3) upon commissioning	Not installed
Volume (m3) per 1 pulse	0.001
Input Settings 3 (NAMUR)	
Input type (sensor or pulse input)	pulsed
Serial number of the connected meter	Not installed
Initial reading (m3) upon commissioning	Not installed
Volume (m3) per 1 pulse	0.001
Input Settings 4 (NAMUR)	
Input type (sensor or pulse input)	pulsed
Serial number of the connected meter	Not installed
Initial reading (m3) upon commissioning	Not installed
Volume (m3) per 1 pulse	0.001

4.2 Information security

Several access levels are available for using the device. The functionality associated with each access level is described in Table 3.

Table 3 - Functionality corresponding to the access level

<table>
<tr><th>Access level</th><th colspan="2">Description</th></tr>
<tr><td rowspan="4">Administrator</td><td colspan="2">This mode allows you to make changes to the device configuration (change the serial number, coefficients, etc.), as well as read the current settings and readings.</td></tr>
<tr><td colspan="2">Default access parameters values</td></tr>
<tr><td>Username</td><td>Password</td></tr>
<tr><td>admin</td><td>admin</td></tr>
<tr><td rowspan="4">User</td><td colspan="2">In this mode, it is possible to read the values of the current settings and readings of the device.</td></tr>
<tr><td colspan="2">Default access parameters values</td></tr>
<tr><td>Username</td><td>Password</td></tr>
<tr><td>user</td><td>user</td></tr>
</table>

When turning on the device for the first time, you must first change the default passwords for each user. Passwords must be 8 characters long and can contain uppercase and lowercase Latin letters, as well as numbers. Password transmission via the RS485 interface from the PC to the device is masked.

5. Protocols and formats of data packets for transmission to the server

5.1 MQTT protocol

Data in the current protocol is transmitted in three different formats. A description of these formats follows.

5.1.1 Thingsboard format

In this format, the transmitted data is divided into two types: telemetry and attributes.

- Telemetry

Telemetry Topic: Topic*(Table 2)/telemetry*

Example of a packet of instantaneous values:

***{"ICCID":** "89701011688875001899", "IN1": "2.162", "IN2": "0.000", "IN3": "3.154", "IN4": "0.000", "INS3": "0", "INS4": "0", "TEMP": "25.6", "CA": "0", **"LP":** "0", "RSSI": "-81", "VB": "3.56"}*

Table 4 - Description of keys

key	***value***	***Descriptio n***
ICCID	*89701011688875001899*	SIM card identifier
IN1	*2.162*	Consumption per input
IN2	*0.000*	Consumption at input 2
IN3	*3.154*	Consumption at input 3
IN4	*0.000*	Consumption at input 4
INS3	*0*	The state of the Namur input connected to input 3 (0 - ***NORMAL, 1 - OPEN, 2 - SHORT CIRCUIT***)
INS4	*0*	The state of the Namur input connected to input 4
TEMP	*25.6*	Temperature measured using a DT sensor connected to the corresponding input.
CA	*0*	Device casing opening failure
LP	*0*	Low battery alarm
RSSI	*-81*	Signal level
VB	*3.56*	Battery charge

Example of consumption profile package:

***[{"ts":** "1584399262000", "values": {"a": "0", "lp": "0", "t": "25", "d1": "2.15", **"d2":** "15.4", "d3": "0", "d4": "0"}}, {"ts": "1584402862000", "values": **"a": "0", "lp": "0", "t": "25", "d1": "2.18", "d2": "16.4", "d3": "0", "d4": "0"}}, {"ts":** "1584406462000", "values": {"a": "0", "lp": "0", "t": "25", "d1": "2.25", **"d2": "17.4", "d3": "0", "d4": "0"}}]*

Table 5 - Description of keys

key	***value***	***Descriptio n***
ts	*1584399262000*	Time stamp of consumption values
values		
a	*0*	Lid opening failure
lp	*0*	Low battery level error
t	*25*	Temperature
d1	*2.15*	Consumption per input
d2	*15.4*	Consumption at input 2

key	value	Description
d3	*0*	Consumption at input 3
d4	*0*	Consumption at input 4

Example of a packet of instantaneous values from an electric meter:

***{"STS_1":** "OK", **"TM_1":** "M230", **"DTM_1":** "170320093842", **"SN_1":** "26939702", **"TFAE_1":** "2.71", **"TFRE_1":** "0.04", **"FAET1_1":** "1.66", **"FAET2_1":** "1.05", **"FAET3_1":** "0.00", **"FAET4_1":** "0.00", **"VPA_1":** "171.97", "VPB_1": "0.00", "VPC_1": "171.22", "APPS_1": "0.00", "RPPS_1": "0.00", "FR_1": "49.99"}*

Table 6 - Description of keys

key	value	Description
STS_1 (_1 index of the counter being polled)	*OK*	Electricity meter polling status Possible response options: - OK - NO ANSWER - NOT OPEN
TM_1	*M230*	Counter type
DTM_1	*170320093842*	*Date and time of the counter*
SN_1	*26939702*	Serial number
TFAE_1	*2.71*	Total active energy
TFRE_1	*0.04*	Total reactive energy
FAET1_1	*1.66*	Active energy at 1 tariff
FAET2_1	*1.05*	Active energy at tariff 2
FAET3_1	*0.00*	Active energy at tariff 3
FAET4_1	*0.00*	Active energy at tariff 4
VPA_1	*171.97*	Voltage in phase A
VPB_1	*0.00*	Phase voltage B
VPC_1	*171.22*	Voltage in phase C
APPS_1	*0.00*	Total active power
RPPS_1	*0.00*	Total reactive power
FR_1	*49.99*	Network frequency

- Attributes

Topic attributes: Topic*(Table 2)/attributes*

Example of an attribute package:

{"ICCID": "89701011688875001899", "TD": "USPD", "VF": "0.0.6", "PF": "30", ***"PFP":** "1440", "PFS": "1440", "PFM": "60"*, **"SNU1":** "*1111111*", **"SNU2":**

"2222222", **"SNU3":***"3333333"*, **"SNU4": "***4444444", "CF1": "0.001", "CF2": "0.01", "CF3": "0.001", "CF4": "0.1", "UTC": "5"}*

Table 7 - Description of keys

key	***value***	***Description***
ICCID	*89701011688875001899*	SIM card identifier
TD	*USPD*	Device type
VF	*0.0.6*	Software version
PF	*30*	Period of sending instantaneous values
PFP	*1440*	Consumption profile sending period for inputs 1-4
PFS	*1440*	Service packet sending period
PFM	*60*	Electric meter data packet sending period
SNU1	*1111111*	Serial number of the device connected to input 1
SNU2	*2222222*	Serial number of the device connected to input 2
SNU3	*3333333*	Device serial number connected to input 3
SNU4	*4444444*	Serial number of the device connected to input 4
CF1	*0.001*	Volume per 1 pulse per 1 input (m3)
CF2	*0.01*	Volume per 1 pulse at 2 inputs (m3)
CF3	*0.001*	Volume per 1 pulse by 3 inputs (m3)
CF4	*0.1*	Volume per 1 pulse at input 4 (m3)
UTC	*5*	Time zone recorded in device

5.1.2 Impact format

When transmitting in this format, there are 2 self-sufficient types of packets.

Topic of packages: Topic*(Table 2)*

The instantaneous value packages, service package, and electricity meter parameter package are similar to the packages described in the previous section. An example of a consumption profile package:

[{"ts":"1584399262000", "a": "0", "lp": "0", "t": "25", "d1": "2.15", "d2": "15.4", "d3": "0", "d4": "0"}, {"ts": "1584402862000", "a": "0", "lp": "0", "t": "25", "d1": "2.18", "d2": "16.4", "d3": "0", "d4": "0"},
{"ts": "1584406462000", "a": "0", "lp": "0", "t": "25", "d1": "2.25", "d2": "17.4", "d3": "0", "d4": "0"}]

The description of the keys is given in Table 4.

5.1.3 Telechet format

When transmitting in this format, there are 2 self-sufficient types of packets.

Topic of packages: Topic*(Table 2)*

Example of a packet of instantaneous values:

{"d": {"ICCID": "89701011688875001899", "IN1": "2.162", "IN2": "0.000", "IN3": "3.154", "IN4": "0.000", "INS3": "0", "INS4": "0", "TEMP": "25.6", "CA": "0", "LP": "0", "RSSI": "-81", "VB": "3.56"}}

The description of the keys is given in
Table 4. Example of consumption profile:

{"d": [{"ts": "1584399262000", "values": {"a": "0", "lp": "0", "t": "25", "d1": "2.15", "d2": "15.4", "d3": "0", "d4": "0"}}, {"ts": "1584402862000", "values": "a": "0", "lp": "0", "t": "25", "d1": "2.18", "d2": "16.4", "d3": "0", "d4": "0"}},
{"ts": "1584406462000", "values": {"a": "0", "lp": "0", "t": "25", "d1": "2.25", "d2": "17.4", "d3": "0", "d4": "0"}}]}

The description of the keys is given in Table 5.
Example of an electric meter parameter package:

{"d": {"STS_1": "OK", "TM_1": "M230", "DTM_1": "170320093842", "SN_1": "26939702", "TFAE_1": "2.71", "TFRE_1": "0.04", "FAET1_1": "1.66", "FAET2_1": "1.05", "FAET3_1": "0.00", "FAET4_1": "0.00", "VPA_1": "171.97", "VPB_1": "0.00", "VPC_1": "171.22", "APPS_1": "0.00", "RPPS_1": "0.00", "FR_1": "49.99"}}

The description of the keys is given in
Table 6. Example of a service package:

{"d": {"imsi": "250990284190501", "typeDevice": "USPD", "pollFrequency": "30", "vFw": "0.0.6", "serialNumber1": "1111111", "serialNumber2": "2222222", "serialNumber3": "3333333", "serialNumber4": "4444444", "c1": "0.001", "c2": "0.01", "c3": "0.001", "c4": "0.1"}}

The description of the keys is given in Table 7.

5.2 COAP protocol

1. Thingsboard format

The package structures and types are similar to those described in section 5.1.1, with one exception:
Attribute transfer topic:
api/v1/$ACCESS_TOKEN (By default is used IMEI

module)/attributes
Telemetry transmission topic:
api/v1/$ACCESS_TOKEN (the module's IMEI is used by default)/telemetry

2. Impact format

The structures of packages and topics are similar to those described in

section 5.1.2.**Uri-Path: Topic (Table 2)**

3. Telechet format

The structures of packages and topics are similar to those described in

section 5.1.3.**Uri-Path: Topic (Table 2)**

6. Working with the device

6.1 Pre-configuring the device

Pre-configuration of the device is required if settings other than factory settings are required. INTable 2 The parameters available for local configuration are listed.

6.2 Local device setup

To configure the device locally, connect a PC to the device's RS485 port and short contacts 4-5 of the XP1 connector using a jumper (this will enter the device's configuration mode). Launch the configuration program on the PC.

The parameters for setting are specified inTable 2.

In addition, you can issue commands from the configurator:

- unscheduled sending of a packet to the server via the LoRaWAN network (used to check the correctness of the device registration and its location within the BS visibility zone),
- reading data from the device (used to check the correct connection of the device to the meter).

The following functionality is also available:

- Reading and changing device settings
- Reading IMSI of SIM card;

6.3 Device operating modes

There are several operating modes of the device:

- **energy-saving**Mode. The device operates in this mode during most of its operating time. It counts pulses, measures battery voltage, and records the activation of connected external sensors and the "Casement Lid Open Sensor." RS485 communication with the configuration software is not possible in this mode.

When any connected sensor or the "Case Open Sensor" is triggered, an alarm message is immediately sent to the server. The device exits "power-saving mode," enters "server communication mode," and sends a packet to the server. After the communication is complete, the device returns to "power-saving mode."

- **"server data exchange mode"**Data transfer to the server occurs at intervals determined by the "Polling Period" parameter. This exits the device's "power-saving" mode. After the transfer is complete, the device returns to "power-saving" mode.

- **"interface device polling mode"**A data slice is recorded in the log. The period must be pre-configured. No transmission to the server occurs.

- **"Local device configuration mode".**This mode can be activated using a button inside the device. This mode is intended for local device configuration from the configurator.

6.4 Indicator

Table 8 – Indicator states

State	State
Mode Indicator	
Indicator operation in module loading mode	
ON – 5..15 sec – OFF	The indicator turns on when power is supplied (or the RES signal is supplied). Remains on while the device initializes. Once initialization is complete, the indicator turns off. the device is ready for use
Operation of the indicator in working mode	
ON – 0.1 sec – OFF	The indicator lights up and goes out once, which informs about the start transfer process
ON – 0.1 sec – OFF–0.1 sec ON – 0.1 sec – OFF	If the data is successfully sent to the server, the indicator will blink twice. lights up briefly and goes out
ON – 0.1 sec – OFF–0.1 sec ON – 0.1 sec – OFF–0.1 sec ON – 0.1 sec – OFF	If data is unsuccessfully sent to the server, the indicator lights up briefly and goes out 3 times.
Indicator operation in setup mode	
ON –0.1 sec –OFF –3 sec.	If no data is recorded or sent to the server, The indicator turns on and off periodically.
Network Indicator	
64ms ON, 800ms OFF	No online registration
64ms ON, 3000ms OFF	Successful registration online
64ms ON, 300ms OFF	Data transfer
OFF	Power off or PSM mode

6.5 Crash sensor "Housing lid opening sensor"

After turning on the power (jumper XP4 pos2-3) or briefly short-circuiting ResetCPU (J1), the device enters operating mode and begins to analyze the states of the connected sensors.

The state of the “Casement Lid Opening Sensor” is analyzed 10 minutes after power is supplied (this makes it convenient when installing the device).

If the "Casement Lid Open Sensor" is triggered, the device's non-volatile memory records readings from all metering devices at the time of the triggering. Readings continue to be recorded. The ALARM status can be reset locally via the configurator ("Measurements"/Instantaneous Values, "Reset Alarms" button) or by sending a command from the server. An example is shown in Figure 2.

6.6 Contact assignment

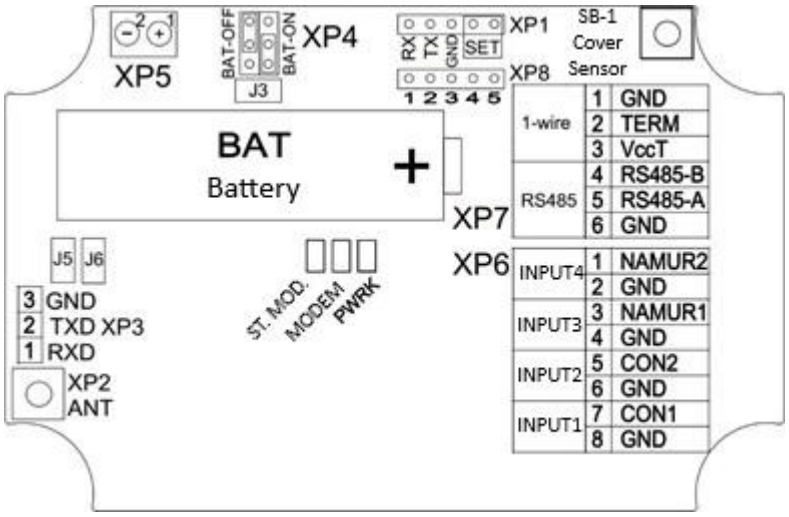

Fig. 2 – XP4 device contacts –

battery enable jumper
SIM-card – holder for installing a SIM card

XP7 – pins 4,5,6 – connection of devices with RS485
XP7 – pins 1,2,3 – connection of temperature sensor

XP6 – cont1,2 – NAMUR2–(Input4) – pulse input or sensor or counter with NAMUR XP6 – cont3,4 – NAMUR1–(Input3) – pulse input or sensor or counter with NAMUR XP6 – cont5,6 – CON1 – (Input1) – pulse input or sensor
XP6 – pin 7,8 – CON2 – (Input 2) – pulse input or sensor

SB1 – lid opening sensor
SB2 - on/off button for local device settings mode

J1 – ResetCPU
XP4 – Bat-ON - jumper for connecting the battery XP4
– Bat-OFF - jumper for disconnecting the battery
XP5 – connection of constant power supply from an external power supply (instead

of a battery) XP1 – pin 4-5 – jumper for operation in the device setup mode

XP1 – UART pin 1(RX), pin 2(TX), pin 3(GND) – device firmware update J2 – jumper for device firmware update

XP3 – UART – modem firmware update

6.7 Typical equipment connection diagram

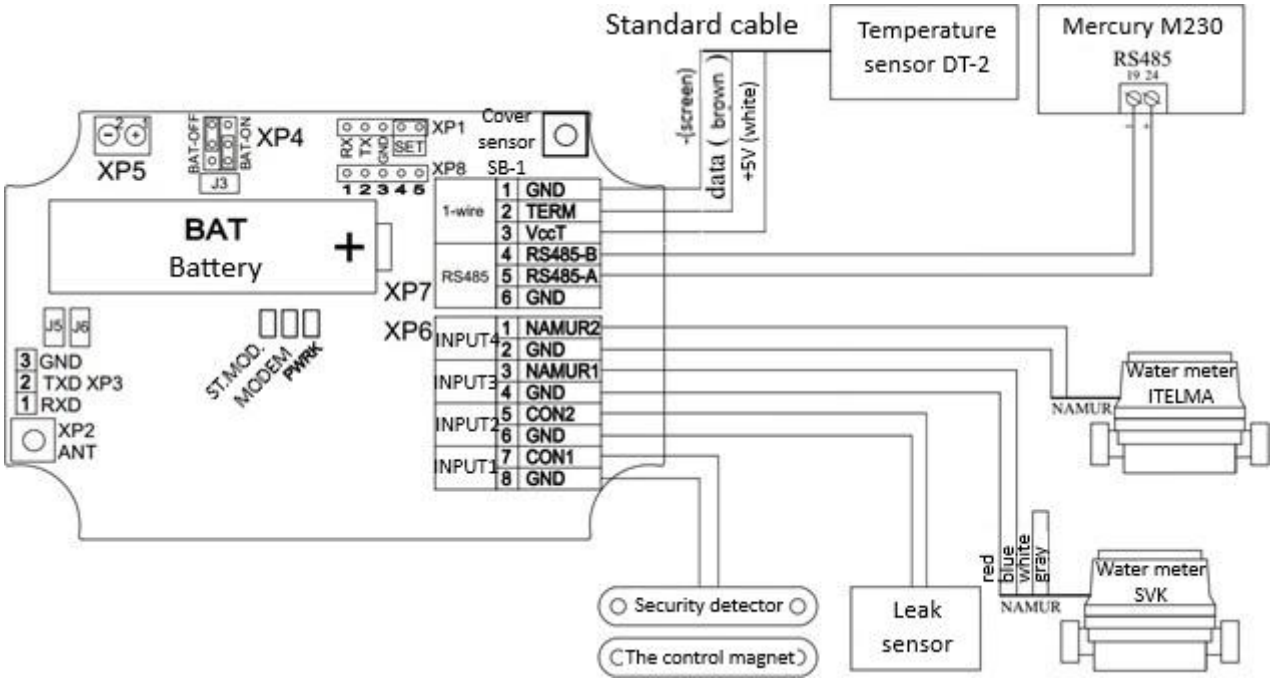

Fig. 3 - Typical device connection diagram

6.8 Connection to UART and RS485 interfaces

For this purpose, one universal converter from Jcom-IoT with USB, UART and RS485 is used - “Converter "USB-RS232-UART-CAN-RS485"” (Figure 4)

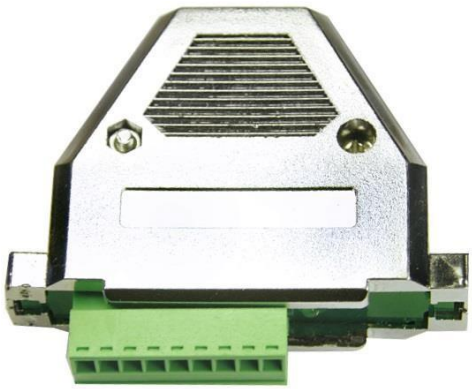

Fig. 4 - “Converter “USB-RS232-UART-CAN-RS485””

If there is no universal converter, two separate specialized converters can be used.

6.8.1 Typical connection diagram to the UART interface

The connection is made according to Figure 5.

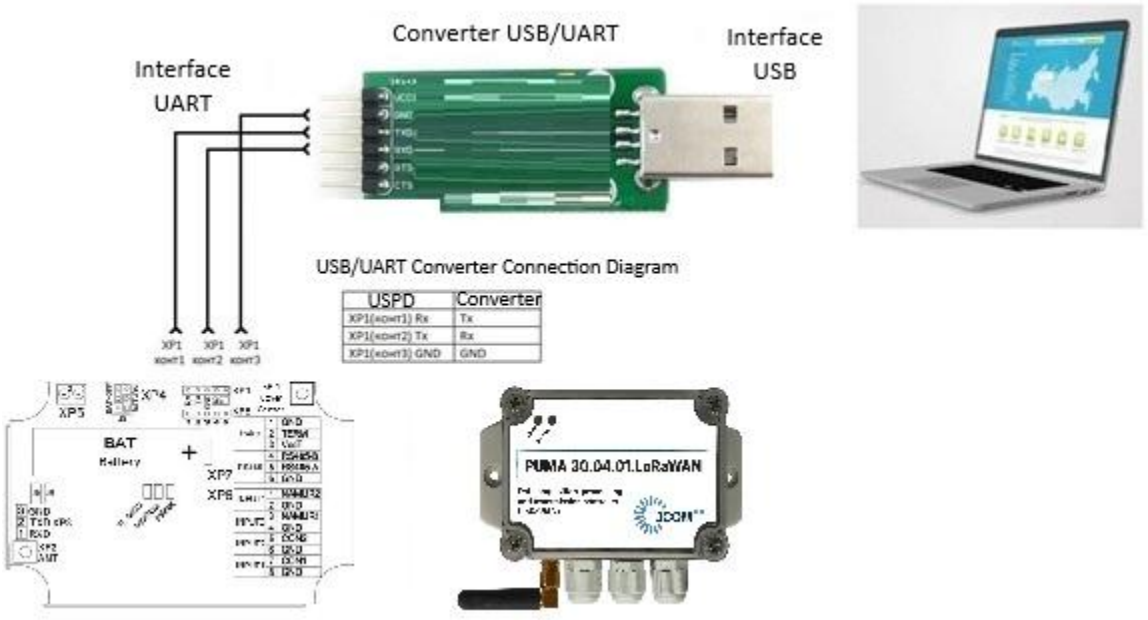

Fig. 5 – Connection to the UART interface

USB/UART converter specifications

- UART voltage levels: 3.3V
- USB converter connector for connecting to a PC (USB type A or USB type B with an additional cable)
- A converter with galvanic isolation is desirable.
- A converter with a terminal block is desirable.
- The XP1(USPD) connector type is PLS-3 (plug, 2.54mm pitch). A cable with a mating PBS-3 receptacle "for connection to PLS-3" is required for connection.
- You may also need a jumper (with a pitch of 2.54) to set “SET”

6.8.2 Typical connection diagram for the RS-485 interface

The connection is made according to Figure 6.

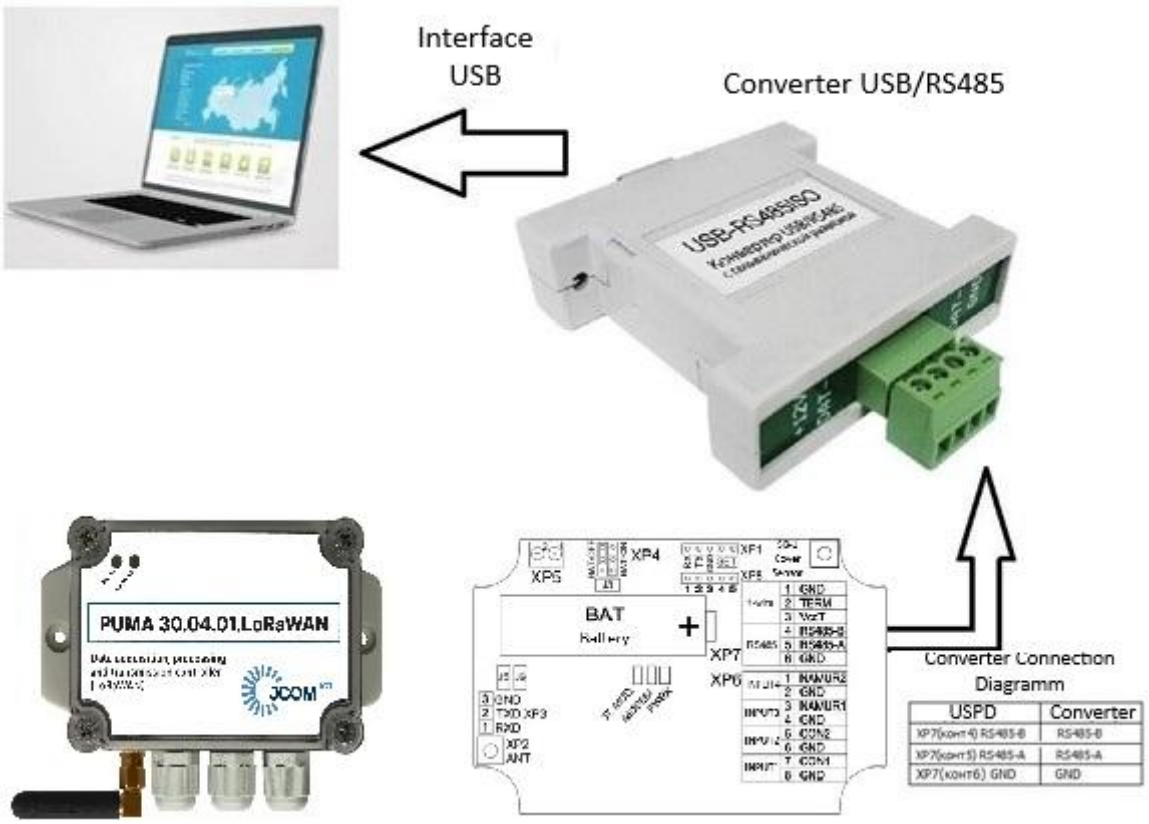

Fig. 6 – Connection to the RS-485 interface

Characteristics of the USB/RS485 converter

- USB converter connector for connecting to a PC (USB type A or USB type B with an additional cable)
- A converter with galvanic isolation is desirable.
- A converter with a terminal block is desirable.
- The XP7 (USPD) connector type is a terminal block. No special cable is required for connection.
- You may also need a jumper (with a pitch of 2.54) to set “SET” XP1(4-5).

7. Completeness

Table 11 - Completeness of PUMA 30.04.01.LoRaWAN

No.	Name	Quantity
1	Data collection and transmission device PUMA 30.04.01.LoRaWAN	1
2	Antenna on a magnetic stand with a 3 m cable.	1
3	User manual	1 (per batch)
4	Passport with warranty card	1
5	Package	1

8. Maintenance

The device is maintenance-free and designed to operate indefinitely under the following operating conditions: stable power supply within the specified voltage range, proper humidity and temperature, non-aggressive gas environment, and absence of shock and vibration. There are no parts inside the device's housing that require periodic inspection and/or maintenance.

9. Storage and transportation rules

Climate conditions transportation should correspond nextconditions:

- ambient air temperature from minus 50℃ to plus 50℃;
- relative air humidity up to 98% at 25℃;
- atmospheric pressure from 84.0 to 107.0 kPa (from 630 to 800 mmHg).

The device can be transported by all types of transport (in covered wagons, closed vehicles, containers).

The device must be stored only in the manufacturer's packaging in heated rooms at temperatures ranging from +5°C to +40°C and relative humidity no more than 80%. Storage areas must be free of aggressive impurities (such as acid or alkali vapors) that could cause corrosion.

10. Manufacturer's warranties(supplier)

The manufacturer guarantees that the device complies with the technical specifications, subject to the conditions of transportation, storage, installation and operation.

The warranty period for the device is set at 2 years, counting from the date the device is put into operation.

During the warranty period of the device, the manufacturer has the right to supervise its correct operation in order to improve the quality and efficiency of operation.

Device components that fail during the warranty period are subject to replacement or repair by the manufacturer at the manufacturer’s expense.

The user loses the right to free repairs during the warranty period in the event of broken seals, mechanical damage by the user, or if the device was repaired by a person who is not authorized to perform repairs and maintenance.