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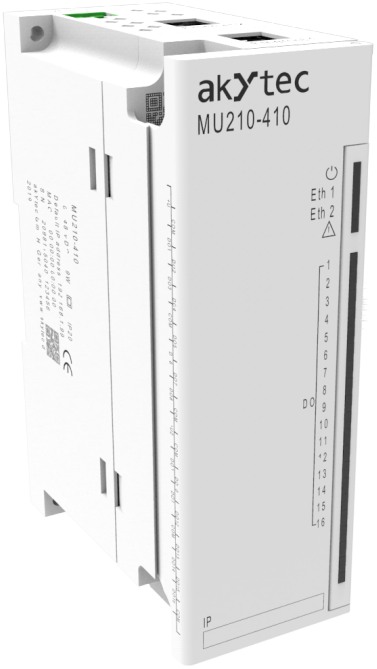

MU210-410

Output module

User guide

MU210-410_3-EN-43711-1.7

Contents

Warning notice system

Explanation of the symbols and keywords used:

DANGER
DANGER indicates an **imminent dangerous situation** that will result in death or serious injuries if not prevented.

CAUTION
CAUTION indicates a **potentially dangerous situation** that could result in minor injuries.

NOTICE
NOTICE indicates a **potentially dangerous situation** that could result in damage to property.

NOTE
NOTE indicates helpful tips and recommendations, as well as information for efficient and trouble-free operation.

Safety

Read this manual carefully before installing, operating or servicing the device.

The device has been designed and built solely for the intended use described in this guide, and can only be used accordingly. The technical specifications contained in this guide must be observed.

Any other use is considered improper.

CAUTION
This device must not be used for medical devices which receive, control or otherwise affect human life or physical health.

When installing and using this product, all applicable state, federal and local regulations must be observed.

Based on safety considerations and compliance with the data provided in the documents, the repair of the components of the products is carried out exclusively by the manufacturer.

There is a dangerous voltage on the terminal block. Any connections to the device and maintenance operations must be carried out only when the power of the device is turned off.

The device's method of protection against electric shock meets the terms of class II, IEC 61131-2-2012.

The device installation must be performed in particularized equipment cabinet, the inner access to which is allowed only to approved specialists.

CAUTION
It is forbidden to use the device in corrosive environments with acids, alkalis, oils, etc. in the atmosphere.

Obey all the necessary rules and instructions when using programmable logic controllers in areas where technical safety requirements apply.

Failure to obey these warnings could result in personal injury or equipment damage.

Akytec company shall not be liable for technical or editorial errors or omissions contained in this document.

Introduction

This document provides detailed information about the operation principle, design, configuration, installation and maintenance of the digital output module MU210-410, hereinafter referred to as the Device or Module.

Connection, adjustment and maintenance of the device must be carried out only by qualified personnel after reading this operating manual.

Order code: **MU210-410**.

Abbreviations

- **PC** – personal computer.
- **PLC** – programmable logic controller.
- **PWM** – pulse width modulation.
- **RTC** – real time clock.
- **USB** – an industry standard that establishes specifications for cables, connectors and protocols for connection, communication and power supply between personal computers and their peripheral devices.
- **UTC** – coordinated universal time.

1 Overview

The Module is designed to control executive devices on automation facilities. The Device is controlled by a PLC, panel controller, PC or other control device.

The module has 16 digital outputs of the transistor switch type.

Modules are used in various fields of industry and agriculture.

2 Specifications

2.1 Specifications

Table 2.1 Specifications

Denomination		Value	
Power supply			
Power supply		24 (10 … 48) V DC	
Power consumption		5 W	
Protection against reverse polarity of supply voltage		Yes	
Interfaces			
Data transfer interface		Dual Port Ethernet 10/100 Mbit	
Configuration interface		USB 2.0 (MicroUSB), Ethernet 10/100 Mbit	
Date transfer protocol		Modbus TCP	
Protocol version		IPv4	
Digital outputs			
Number of outputs		16 (2 groups of 8 outputs)	
Output type		Transistor switch	
Operation mode		– switching of a logic state; – low-frequency PWM signal generation; – high frequency PWM signal generation (first 8 outputs only); – generation of a given number of pulses (only the first 3 outputs)	
Output switching mode		High-side switch	Push-pull output
Output power supply		10…36 V	
Maximum DC load current		0.8 A	0.1 A
Maximum allowed short-time output current		1.3 A	0.19 A
Maximum output frequency (for resistive load)		10,000 Hz	60,000 Hz
Minimum duration of output signal (for resistive load)		10 µs	1 µs
Maximum load capacity		1 µF with a load resistance of at least 500 Ω	
Output protection type		– protection against short circuit when switching on; – protection against low and high voltage power outputs; – protection against overheating of the output stage; – output overcurrent protection; – self-induction reverse current protection	
Flash-memory (log-file)			
Number of write and erase cycles		Up to 100,000	
Maximum log file size		2 KB	
Maximum number of log files		1000	
Minimum log writing interval		10 s	
Real time clock			
Inaccuracy	at +25 °C	max. 3 s per day	
	over the entire temperature range	max. 10 s per day	
Battery type		CR2032	

Denomination	Value
Lifetime of one battery	6 years
General specifications	
Dimensions	42 × 124 × 83 mm
Ingress protection rating	IP20
Error-free running time*	60,000 h
Average service life time	10 years
Weight	0.4 kg

* Except real-time clock battery

2.2 Isolation of the Device Components

The circuit of galvanic isolated components and the strength of galvanic isolation are shown in *Figure 2.1*.

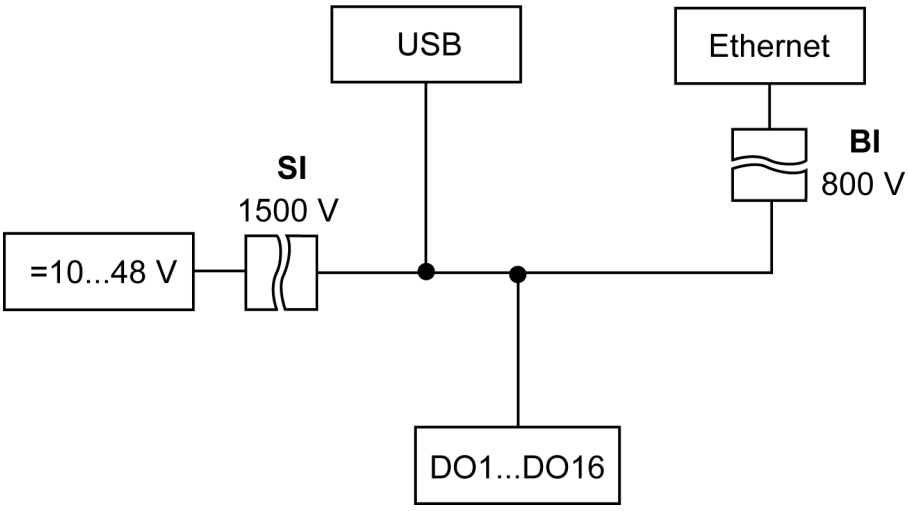

Fig. 2.1 Isolation of the Device Components

Table 2.2 Insulation types

Type	Description
Basic insulation (BI)	The insulation used for active parts of equipment to provide protection against electric shock. The electrical strength of the basic insulation is checked by type tests: by applying a test AC voltage, the value of which is different for different circuits of the Device
Supplementary insulation (SI)	Independent insulation used in addition to the basic insulation in order to guarantee protection against electric shock in the event of a failure of the main insulation The electrical strength of the supplementary insulation is checked by type tests: by applying an alternating test AC voltage of various levels (RMS value)

NOTICE
The strength of the isolation is indicated for testing under normal climatic conditions (exposure time is 1 minute).

2.3 Environmental conditions

The Module meets the requirements for immunity to interference in accordance with IEC 61000-6-4:2006. According to the level of emission of radio interference (noise emissions) the Device complies with the standards established for equipment of class A by CISPR 22-97. The Device is designed for operation in the following conditions:

– ambient temperature: –40 … +55 °C;

– relative humidity: up to 95% (at +35 °C, non-condensing);
– closed non-hazardous areas, free of corrosive or flammable gases.
– permitted pollution degree 1 according to IEC 61131-2.

The resistance to mechanical influences during operation of the Device is in accordance with IEC 61131-2-2012.

The resistance to climatic influences during the operation of the Device is in accordance with IEC 61131-2-2012.

3 Installation

Module is to install in the electrical cabinet. The design of the cabinet must protect Module from moisture, dirt and foreign objects.

To install Module:

1. Make sure that there is enough free space to connect the wire harness. You need 50 mm above the Module and below it.
2. Fasten the Device to the DIN rail or to a vertical surface using screws (see *Figure 3.1*).

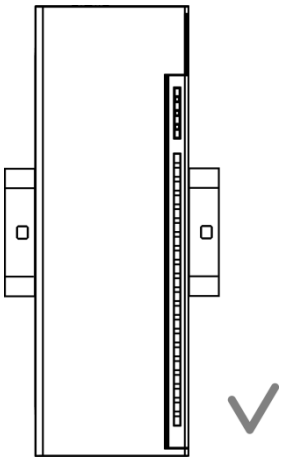

Fig. 3.1 Proper installation

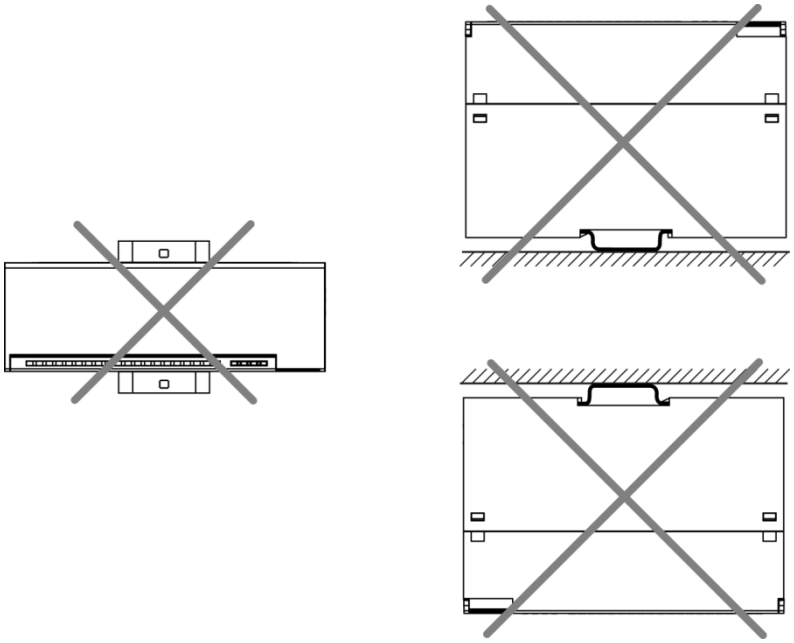

Fig. 3.2 Improper installation

CAUTION
Long-term operation of Module with improper installation can lead to damage (see *Figure 3.2*).

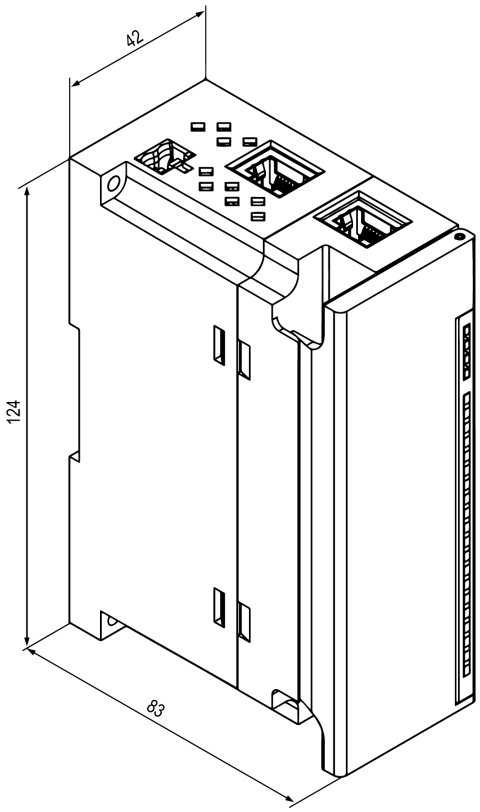

Fig. 3.3 Dimension drawing

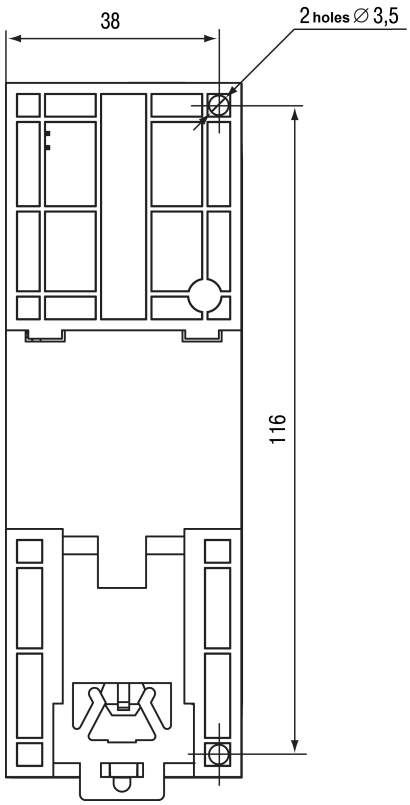

Fig. 3.4 Mounting dimensions

4 Connection

4.1 Connection recommendations

Mounting of external connections must be carried out by a wire with a cross section of not more than 0.75 mm².

For stranded wires, use end sleeves.

After mounting, put the wires into the cable channel of Module housing and close the cover.

If necessary, remove the terminal blocks of Module, loosen the two screws at the corners of the terminal blocks.

The power wires must be mounted using the supplied return terminal block.

CAUTION
Connection and maintenance is performed only when power of Module and devices connected to it is turned off.

CAUTION
Do not connect wires of different cross-sections to one terminal.

CAUTION
Do not connect more than two wires to one terminal.

4.2 Terminal block layout

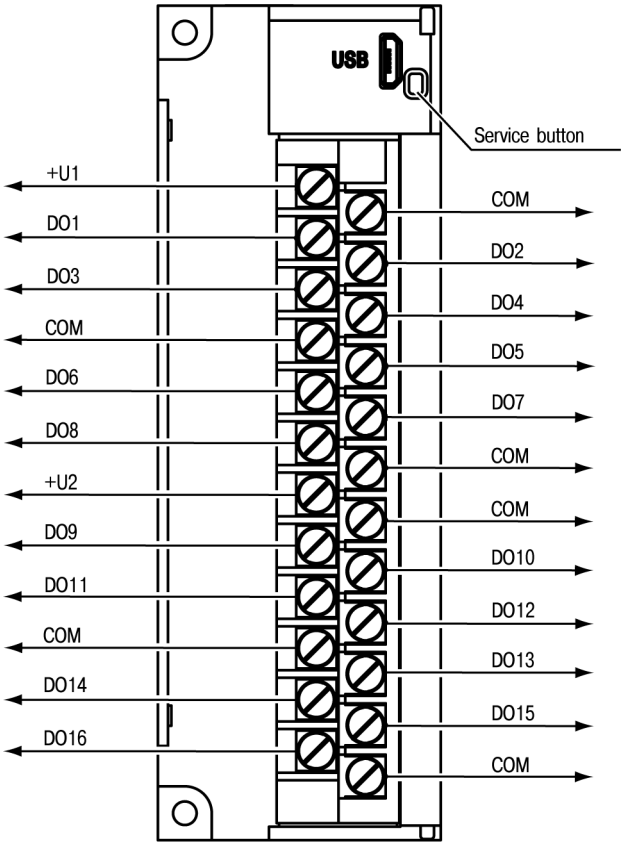

Fig. 4.1 Terminal block layout

Denomination	Overview
+U1	Output supply voltage DO1-DO8
+U2	Output supply voltage DO9-DO16

Denomination	Overview
COM	Common output power supply point
DO1–DO16	Outputs DO1–DO16

4.3 Connectors

The connectors of the interfaces and of the power supply of the Device are shown in *Figure 4.2*.

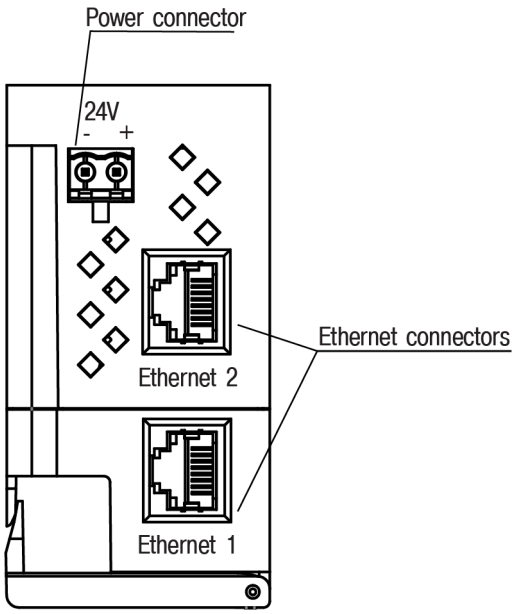

Fig. 4.2 Device's connectors

4.4 Power supply

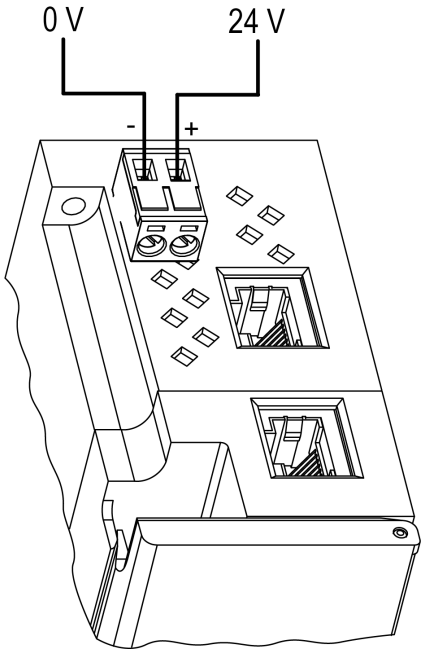

Fig. 4.3 Power supply contacts

CAUTION
Using power supplies without potential isolation or with basic isolation of low voltage circuits from AC lines can lead to dangerous voltage in the circuits.

4.5 Connection to the outputs

Figure 4.4 shows the connection of the load to the outputs of the transistor switch type.

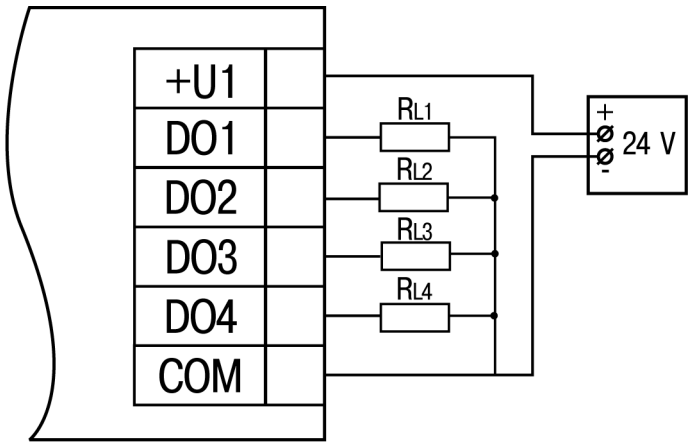

Fig. 4.4 External connections to digital outputs of the transistor switch type

The positive pole of the supply voltage of the outputs is fed to the + U1, + U2 terminal to power the outputs DO1–DO8, DO9–DO16 respectively.

It is allowed to use one or two different power sources for connection to the terminals + U1 and + U2. It is allowed to use power supplies with different rated output voltage in the range of 10 … 36 V.

The common power supply terminals of the outputs (COM) are integrated inside the module.

The maximum length of the power supply line of the outputs from the power supply to the + U1, + U2 terminals is 30 meters.

4.6 Ethernet connection

To connect modules to an Ethernet network, you can use the following schemes:

– Wye (*Figure 4.5*),
– Daisy-chain (*Figure 4.6*).

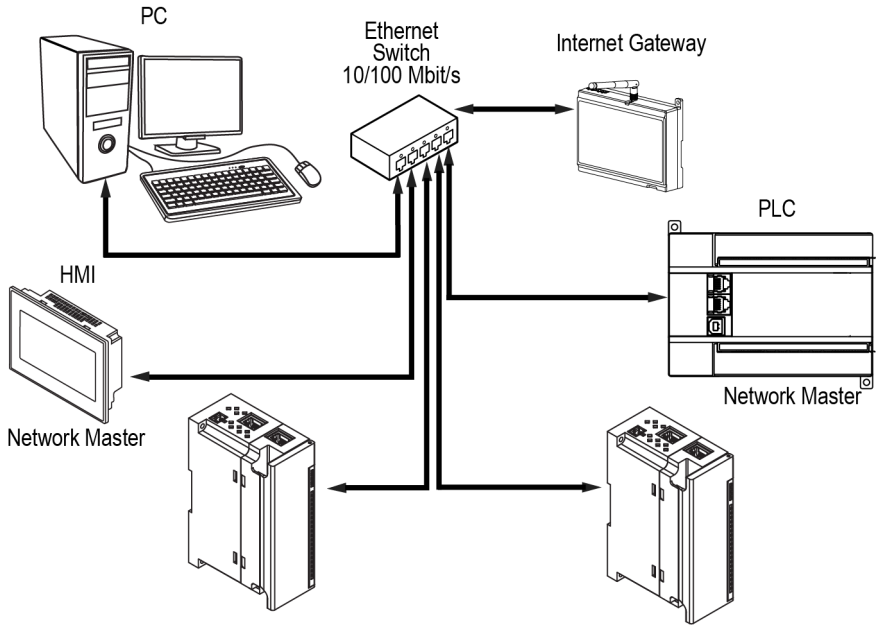

Fig. 4.5 Wye connection

NOTICE

1. Maximum length of communication lines: 100 m.
2. Connection is possible to any Ethernet port of the module.
3. The unused Ethernet port must be closed with a blanking plug.

To connect to the Daisy-chain scheme, you must use both Ethernet ports of Module. If Module fails or the power is turned off, the data will be transferred from port 1 to port 2 without disconnecting.

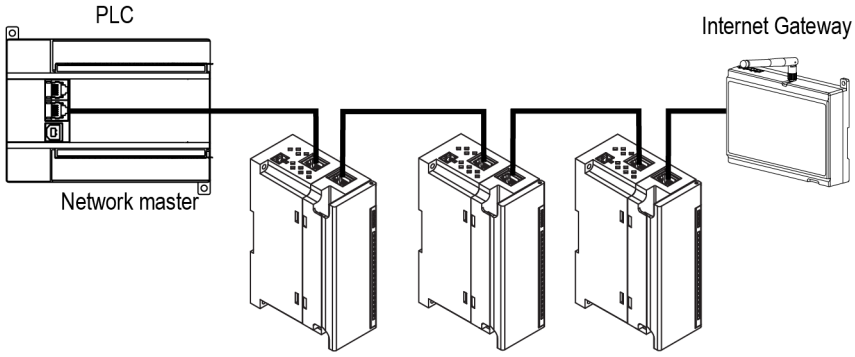

Fig. 4.6 Daisy-chain connection

NOTICE

1. The maximum length of the communication line between two adjacent active devices when connected with the “Daisy-Chain” must be not more than 100 m.
2. An adjacent connection scheme is allowed.
3. The unused Ethernet port should be closed with a blanking plug.

5 Construction and operation

5.1 Operation principle

The Module receives commands to control outputs from the Network Master.
As a Network Master you can use:
– PC;
– PLC;
– Operator panel.

5.2 Indication and control

Indication elements are located on the front panel of the Device, see *Table 5.1*.

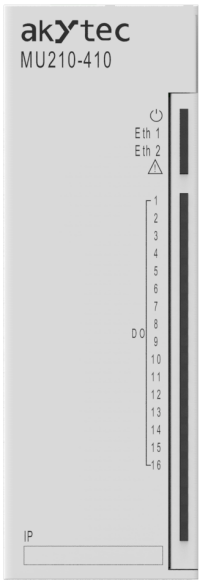

Fig. 5.1 Device faceplate

The IP field is located at the bottom of the front panel.

NOTICE
The IP field is intended for applying the IP address of the Module with a thin marker or on a paper sticker.

Table 5.1 LED States

LED	LED Status	Function
Power ⏻ (green)	ON	Device operating voltage is applied
Eth 1 (green)	Flashing	Data transfer via Ethernet port 1
Eth 2 (green)	Flashing	Data transfer via Ethernet port 2
Fault ⚠ (red)	OFF	Normal operation
	ON	Main application and / or configuration failure
	Lights 200 ms once every 3 seconds	It is necessary to replace the battery of RTC

LED	LED Status	Function
	Lights 100 ms twice a second (after a pause of 400 ms)	Module is in a safe state
	900 ms on, 100 ms off	Hardware peripheral failure (Flash, RTC, Ethernet Switch)
Output status indicators (red-green)	Green	Output on
	OFF	Output off
	Red (for outputs)	Output fault

Under the module faceplate there are terminal blocks and a service button (*Figure 4.1*).

The service button performs the following functions:

– Factory settings restore (*Section 6.6*);
– IP-address assignment (*Section 6.2*);
– Firmware update (*Section 6.4*).

5.3 Real time clock

The Module has a built-in real time clock (RTC). Its source of power is a battery.

The timing is in seconds, starting with January 1, 2000 at midnight UTC. RTC indication is used for writing entries into the log file.

5.4 Log file

The module has built-in encrypted flash memory. The encryption algorithm is Data Encryption Standard (DES) in cipher block chaining (CBC) mode. The key is the string **superkey**. An initialization vector is generated using a hash function. The function argument is the password specified in akYtecToolPro. A checksum is calculated by the CRC32 algorithm and saved in the file end. The checksum is also encrypted.

Log file of Module will be saved as a few files. The log interval, the restriction on the size of one file and their number is set by the user in akYtecToolPro. If the log file is full, then the data is overwritten, starting with the oldest data in the oldest file.

A log file is a collection of records. Entries are separated by line break characters (0x0A0D). Each entry corresponds to one parameter and consists of fields separated by the “;” character (without quotes). Entry format is shown in table.

Table 5.2 Entry format

Parameter	Type	Size	Comment
Time stamp	binary data	4 bytes	In seconds from 00:00 01.01.2000 (UTC+0)
Separator	string	1 byte	Character ";" (without quotes)
Unique identifier of the parameter (UID)	string	8 byte	As a string of HEX characters with leading zeros
Separator	string	1 byte	Character ";" (without quotes)
Parameter value	string	depending on the parameter	As a string of HEX characters with leading zeros
Separator	string	1 byte	Character ";" (without quotes)
Parameter Status	binary data	1 byte	parameter status in the log file (0 – the parameter value is correct, 1 – the parameter value is incorrect and its further processing is not recommended).
Line break	binary data	2 bytes	\n\r (0x0A0D)

Example of decrypted entry:

0x52 0x82 0xD1 0x24 **0x3B** 0x30 0x30 0x30 0x30 0x61 0x39 0x30 0x30 **0x3B** 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x31 **0x3B** 0x31 ***0x0A 0x0D***

where

– 0x52 0x82 0xD1 0x24 – time stamp. To get the date and time in UnixTime format, it is necessary to reverse the byte order and add the offset constant (number of seconds between 00:00:00 01/01/1970 and 00:00:00 01/01/2000): 0x24D18252 (HEX) + 946684800 (DEC) = 1564394971 (DEC, corresponding to July 29, 2019, 10:09:31);

– **0x3B** – separator;

– 0x30 0x30 0x30 0x30 0x30 0x61 0x39 0x30 0x30 – unique identifier of the parameter (00003ba00);

– **0x3B** – separator;

– 0x30 0x30 0x30 0x30 0x30 0x30 0x30 0x31 – parameter value (00000001);

– **0x3B** – separator;

– 0x31 – parameter status (1 – parameter value is correct);

– ***0x0A 0x0D*** – line break characters.

The time is written to the file from the built-in real time clock. You can also set the time zone, which will be read by external software.

The log file in the Device is written with a interval specified by user. Writing occurs with a certain frequency, calculated in such a way that the resource of Device flash memory is sufficient for a period of at least 10 years of operation.

Log file can be read:

– by akYtecToolPro;

– by user software (using Modbus function 20).

The list of logged parameters is available in the akYtecToolPro software on the ***Device Information*** tab. The order of writing parameters to the log file corresponds to the order of parameters on the tab.

NOTE
After updating the firmware, all device settings except the network settings will be reset to the factory settings.

The log file is read using the Modbus function 20 (0x14). This function returns the contents of the registers of the memory file. The function allows using one request to read one or several records from one or several files.

The file read request for each entry indicates:

– link type, 1 byte (should be equal to 6);

– file number, 2 bytes;

– starting address of the register inside the file, 2 bytes;

– number of registers to read, 2 bytes.

NOTE
The file number in the Mobus request is calculated as 4096 + the file sequence number. Sequential file numbering is from scratch. The Last log file index contains the sequential number of the log file for the last time data were written.

The number of readable registers in the request should be selected so that the length of the response does not exceed the allowable length of the Modbus packet (256 bytes).

The size of the log file is not known in advance, so you should read portions of the data using separate queries. If in response to the request a message is received with error code 0x04 (MODBUS_SLAVE_DEVICE_FAILURE), then you can conclude that the addresses of the registers in the request are outside the file. To read the latest file data, you need to reduce the number of registers in the request.

CAUTION
When the Module power is turned off, the last entry made at the time of power off may not be saved.

5.5 Data exchange modes

The Module has the following data exchange modes:

– exchange with the Master via the Modbus TCP protocol (port 502) – up to 4 simultaneous connections with different Network Masters;
– connection and data exchange with a PC using the akYtec Tool Pro.

5.5.1 Modbus TCP communication

Table 5.3 Reading and writing parameters using the Modbus TCP protocol

Operation	Function
Reading	3 (0x03) or 4 (0x04)
Writing	6 (0x06) or 16 (0x10)

The list of Modbus registers is read from the device using the akYtecToolPro program in the “Device Parameters” tab. This list of Modbus registers is presented in the tables below.

Table 5.4 General Registers for Online Modbus Communication

Name	Register	Size/type/description
Device name (DEV)	0xF000	Character string up to 32 bytes, Win1251 encoding
Firmware version (VER)	0xF010	Character string up to 32 bytes, Win1251 encoding
Platform name	0xF020	Character string up to 32 bytes, Win1251 encoding
Platform version	0xF030	Character string up to 32 bytes, Win1251 encoding
Hardware version	0xF040	Character string up to 16 bytes, Win1251 encoding
Additional character information	0xF048	Character string up to 16 bytes, Win1251 encoding
Time and date	0xF080	4 bytes, in seconds since 2000
Time zone	0xF082	2 bytes, signed short, offset in minutes from Greenwich
Serial number	0xF084	Character string 32 bytes, encoding Win1251, 17 characters are used

Table 5.5 Modbus communication registers

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Mode for output DO1	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency; 3 – pulse generator	272	0x110	Read and write	UINT 16
Mode for output DO2	0 – switching of a logic signal; 1 – PWM low frequency;	273	0x111	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
	2 – PWM high frequency; 3 – pulse generator				
Mode for output DO3	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency; 3 – pulse generator	274	0x112	Read and write	UINT 16
Mode for output DO4	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency	275	0x113	Read and write	UINT 16
Mode for output DO5	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency	276	0x114	Read and write	UINT 16
Mode for output DO6	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency	277	0x115	Read and write	UINT 16
Mode for output DO7	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency	278	0x116	Read and write	UINT 16
Mode for output DO8	0 – switching of a logic signal; 1 – PWM low frequency; 2 – PWM high frequency	279	0x117	Read and write	UINT 16
Mode for output DO9	0 – switching of a logic signal; 1 – PWM low frequency	280	0x118	Read and write	UINT 16
Mode for output DO10	0 – switching of a logic signal;	281		Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
	1 – PWM low frequency				
Mode for output DO11	0 – switching of a logic signal; 1 – PWM low frequency	282	0x119	Read and write	UINT 16
Mode for output DO12	0 – switching of a logic signal; 1 – PWM low frequency	283	0x11B	Read and write	UINT 16
Mode for output DO13	0 – switching of a logic signal; 1 – PWM low frequency	284	0x11C	Read and write	UINT 16
Mode for output DO14	0 – switching of a logic signal; 1 – PWM low frequency	285	0x11D	Read and write	UINT 16
Mode for output DO15	0 – switching of a logic signal; 1 – PWM low frequency	286	0x11E	Read and write	UINT 16
Mode for output DO16	0 – switching of a logic signal; 1 – PWM low frequency	287	0x11F	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	308	0x134	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	309	0x135	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	310	0x136	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	311	0x137	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	312	0x138	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	313	0x139	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	314	0x13A	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Period of low frequency PWM on output DO1	1000…60000 (ms)	315	0x13B	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	316	0x13C	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	317	0x13D	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	318	0x13E	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	319	0x13F	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	320	0x140	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	321	0x141	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	322	0x142	Read and write	UINT 16
Period of low frequency PWM on output DO1	1000…60000 (ms)	323	0x143	Read and write	UINT 16
Duty cycle of PWM-generator for output DO1	0…1000 (0.10 %)	340	0x154	Read and write	UINT 16
Duty cycle of PWM-generator for output DO2	0…1000 (0.10 %)	341	0x155	Read and write	UINT 16
Duty cycle of PWM-generator for output DO3	0…1000 (0.10 %)	342	0x155	Read and write	UINT 16
Duty cycle of PWM-generator for output DO4	0…1000 (0.10 %)	343	0x156	Read and write	UINT 16
Duty cycle of PWM-generator for output DO5	0…1000 (0.10 %)	344	0x158	Read and write	UINT 16
Duty cycle of PWM-generator for output DO6	0…1000 (0.10 %)	345	0x159	Read and write	UINT 16
Duty cycle of PWM-generator for output DO7	0…1000 (0.10 %)	346	0x15A	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Duty cycle of PWM-generator for output DO8	0…1000 (0.10 %)	347	0x15B	Read and write	UINT 16
Duty cycle of PWM-generator for output DO9	0…1000 (0.10 %)	348	0x15C	Read and write	UINT 16
Duty cycle of PWM-generator for output DO10	0…1000 (0.10 %)	349	0x15D	Read and write	UINT 16
Duty cycle of PWM-generator for output DO11	0…1000 (0.10 %)	350	0x15E	Read and write	UINT 16
Duty cycle of PWM-generator for output DO12	0…1000 (0.10 %)	351	0x15F	Read and write	UINT 16
Duty cycle of PWM-generator for output DO13	0…1000 (0.10 %)	352	0x160	Read and write	UINT 16
Duty cycle of PWM-generator for output DO14	0…1000 (0.10 %)	353	0x161	Read and write	UINT 16
Duty cycle of PWM-generator for output DO15	0…1000 (0.10 %)	354	0x162	Read and write	UINT 16
Duty cycle of PWM-generator for output DO16	0…1000 (0.10 %)	355	0x163	Read and write	UINT 16
Frequency of the pulse generator for DO1	1…60000 (Hz)	372	0x174	Read and write	UINT 16
Frequency of the pulse generator for DO2	1…60000 (Hz)	373	0x175	Read and write	UINT 16
Frequency of the pulse generator for DO3	1…60000 (Hz)	374	0x176	Read and write	UINT 16
Number of pulses of the pulse generator for outputs DO1	0…65535 (pulses)	404	0x194	Read and write	UINT 16
Number of pulses of the pulse generator for outputs DO2	0…65535 (pulses)	405	0x195	Read and write	UINT 16
Number of pulses of the pulse generator for outputs DO3	0…65535 (pulses)	406	0x196	Read and write	UINT 16
Diagnostics of the output DO1	0 – off 1 – on	436	0x1B4	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Diagnostics of the output DO2	0 – off 1 – on	437	0x1B5	Read and write	UINT 16
Diagnostics of the output DO3	0 – off 1 – on	438	0x1B6	Read and write	UINT 16
Diagnostics of the output DO4	0 – off 1 – on	439	0x1B7	Read and write	UINT 16
Diagnostics of the output DO5	0 – off 1 – on	440	0x1B8	Read and write	UINT 16
Diagnostics of the output DO6	0 – off 1 – on	441	0x1B9	Read and write	UINT 16
Diagnostics of the output DO7	0 – off 1 – on	442	0x1BA	Read and write	UINT 16
Diagnostics of the output DO8	0 – off 1 – on	443	0x1BB	Read and write	UINT 16
Diagnostics of the output DO9	0 – off 1 – on	444	0x1BC	Read and write	UINT 16
Diagnostics of the output DO10	0 – off 1 – on	445	0x1BD	Read and write	UINT 16
Diagnostics of the output DO11	0 – off 1 – on	446	0x1BE	Read and write	UINT 16
Diagnostics of the output DO12	0 – off 1 – on	447	0x1BF	Read and write	UINT 16
Diagnostics of the output DO13	0 – off 1 – on	448	0x1C0	Read and write	UINT 16
Diagnostics of the output DO14	0 – off 1 – on	449	0x1C1	Read and write	UINT 16
Diagnostics of the output DO15	0 – off 1 – on	450	0x1C2	Read and write	UINT 16
Diagnostics of the output DO16	0 – off 1 – on	451	0x1C3	Read and write	UINT 16
Output status bitmask	0…65535	468	0x1D4	Read only	UINT 16
Bitmask for setting of output status	0…65535	470	0x1D6	Read and write	UINT 16
Bitmask of the state of the relay and load interruption monitoring	0…65535	472	0x1D8	Read only	UINT 16
Safe state value for output DO1	0…1000 (0.10 %)	474	0x1DA	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Safe state value for output DO2	0…1000 (0.10 %)	475	0x1DB	Read and write	UINT 16
Safe state value for output DO3	0…1000 (0.10 %)	476	0x1DC	Read and write	UINT 16
Safe state value for output DO4	0…1000 (0.10 %)	477	0x1DD	Read and write	UINT 16
Safe state value for output DO5	0…1000 (0.10 %)	478	0x1DE	Read and write	UINT 16
Safe state value for output DO6	0…1000 (0.10 %)	479	0x1DF	Read and write	UINT 16
Safe state value for output DO7	0…1000 (0.10 %)	480	0x1E0	Read and write	UINT 16
Safe state value for output DO8	0…1000 (0.10 %)	481	0x1E1	Read and write	UINT 16
Safe state value for output DO9	0…1000 (0.10 %)	482	0x1E2	Read and write	UINT 16
Safe state value for output DO10	0…1000 (0.10 %)	483	0x1E3	Read and write	UINT 16
Safe state value for output DO11	0…1000 (0.10 %)	484	0x1E4	Read and write	UINT 16
Safe state value for output DO12	0…1000 (0.10 %)	485	0x1E5	Read and write	UINT 16
Safe state value for output DO13	0…1000 (0.10 %)	486	0x1E6	Read and write	UINT 16
Safe state value for output DO14	0…1000 (0.10 %)	487	0x1E7	Read and write	UINT 16
Safe state value for output DO15	0…1000 (0.10 %)	488	0x1E8	Read and write	UINT 16
Safe state value for output DO16	0…1000 (0.10 %)	489	0x1E9	Read and write	UINT 16
Frequency of high frequency PWM for output DO1	1…60000 (Hz)	506	0x1FA	Read and write	UINT 16
Frequency of high frequency PWM for outputs DO2	1…60000 (Hz)	507	0x1FA	Read and write	UINT 16
Frequency of high frequency PWM for output DO3	1…60000 (Hz)	508	0x1FB	Read and write	UINT 16
Frequency of high frequency PWM for output DO4	1…60000 (Hz)	509	0x1FD	Read and write	UINT 16
Frequency of high frequency	1…60000 (Hz)	510	0x1FE	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
PWM for output DO5					
Frequency of high frequency PWM for output DO6	1…60000 (Hz)	511	0x1FF	Read and write	UINT 16
Frequency of high frequency PWM for output DO7	1…60000 (Hz)	512	0x200	Read and write	UINT 16
Frequency of high frequency PWM for output DO8	1…60000 (Hz)	513	0x201	Read and write	UINT 16
Counter value of the pulse generator for the output DO1	1…65535 (pulses)	538	0x21A	Read only	UINT 16
Counter value of the pulse generator for the output DO2	1…65535 (pulses)	539	0x21B	Read only	UINT 16
Counter value of the pulse generator for the output DO3	1…65535 (pulses)	540	0x21C	Read only	UINT 16
Switching mode for output DO1	0 – high-side switch 1 – push-pull output	570	0x23A	Read and write	UINT 16
Switching mode for output DO2	0 – high-side switch 1 – push-pull output	571	0x23B	Read and write	UINT 16
Switching mode for output DO3	0 – high-side switch 1 – push-pull output	572	0x23C	Read and write	UINT 16
Switching mode for output DO4	0 – high-side switch 1 – push-pull output	573	0x23D	Read and write	UINT 16
Switching mode for output DO5	0 – high-side switch 1 – push-pull output	574	0x23E	Read and write	UINT 16
Switching mode for output DO6	0 – high-side switch 1 – push-pull output	575	0x23F	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Switching mode for output DO7	0 – high-side switch 1 – push-pull output	576	0x240	Read and write	UINT 16
Switching mode for output DO8	0 – high-side switch 1 – push-pull output	577	0x241	Read and write	UINT 16
Switching mode for output DO9	0 – high-side switch 1 – push-pull output	578	0x242	Read and write	UINT 16
Switching mode for output DO10	0 – high-side switch 1 – push-pull output	579	0x243	Read and write	UINT 16
Switching mode for output DO11	0 – high-side switch 1 – push-pull output	580	0x244	Read and write	UINT 16
Switching mode for output DO12	0 – high-side switch 1 – push-pull output	581	0x245	Read and write	UINT 16
Switching mode for output DO13	0 – high-side switch 1 – push-pull output	582	0x246	Read and write	UINT 16
Switching mode for output DO14	0 – high-side switch 1 – push-pull output	583	0x247	Read and write	UINT 16
Switching mode for output DO15	0 – high-side switch 1 – push-pull output	584	0x248	Read and write	UINT 16
Switching mode for output DO16	0 – high-side switch 1 – push-pull output	585	0x249	Read and write	UINT 16
Safe state activation timeout	0…60 (s)	700	0x2BC	Read and write	UINT 16
Battery status (power supply)	0…3300 (mV)	801	0x321	Read only	UINT 16
Log interval	10…3600 (s) default value – 30	900	0x384	Read and write	UINT 16

Parameter	Value (unit)	Register address		Access	Data format
		DEC	HEX		
Time (ms)	—	61563	0xF07B	Read only	UINT 32
New time	Date/Time in seconds from January 1, 2000.	61565	0xF07D	Read and write	UINT 32
Write the new time	0 – do not write; 1 – write	61567	0xF07F	Read and write	UINT 16
Time and date (UTC)	Date/Time in seconds from January 1, 2000.	61568	0xF080	Read only	UINT 32
Time zone	Offset in minutes from Greenwich	61570	0xF082	Read and write	INT 16
Device status	—	61620	0xF0B4	Read only	UINT 32
MAC-address	—	61696	0xF100	Read only	UINT 48
DNS server 1	—	12	0xC	Read and write	UINT 32
DNS server 2	—	14	0xE	Read and write	UINT 32
Assign IP address	—	20	0x14	Read and write	UINT 32
Enter subnet mask	—	22	0x16	Read and write	UINT 32
Set the gateway IP address	—	24	0x18	Read and write	UINT 32
Current IP address	—	26	0x1A	Read only	UINT 32
Current subnet mask	—	28	0x1C	Read only	UINT 32
Current gateway IP address	—	30	0x1E	Read only	UINT 32
DHCP Mode	0 – absolute prohibition 1 – read only 2 – write only	32	0x20	Read and write	UINT 16

5.5.2 Error codes for Modbus protocol

When working on the Modbus protocol, errors may occur. These errors are described in *Table 5.6*. In case of an error, Module sends a response to the Network Master with an error code.

Table 5.6 List of possible errors

Name	Code	Description
MODBUS_ILLEGAL_ FUNCTION	01 (0x01)	Illegal function code. The error occurs if Module does not support the Modbus function specified in the request.
MODBUS_ILLEGAL_DATA_ ADDRESS	02 (0x02)	Illegal register address. The error occurs if the request contains register addresses that are not in Module.

Name	Code	Description
MODBUS_ILLEGAL_DATA_ VALUE	03 (0x03)	Illegal data value. The error occurs if the request contains an invalid value for writing to the register
MODBUS_SLAVE_DEVICE_ FAILURE	04 (0x04)	The error occurs if the requested action cannot be completed.

During the exchange via the Modbus protocol, Module checks the compliance of the requests with the Modbus specification. Requests that fail verification are ignored by the module. Requests that specify an address that does not match the module address are also ignored.

Next, the function code is checked. If a request is received by the module with a function code not specified in *Table 5.7*, a MODBUS_ILLEGAL_FUNCTION error occurs.

Table 5.7 List of supported functions

Name	Code	Description
MODBUS_READ_HOLDING_ REGISTERS	3 (0x03)	Reading values from one or more holding registers
MODBUS_READ_INPUT_ REGISTERS	4 (0x04)	Reading values from one or more input registers
MODBUS_WRITE_SINGLE_ REGISTER	6 (0x06)	Writing a value to single register
MODBUS_WRITE_ MULTIPLE_REGISTERS	16 (0x10)	Writing values to multiple registers
MODBUS_READ_FILE_ RECORD	20 (0x14)	Reading log from file
MODBUS_WRITE_FILE_ RECORD	21 (0x15)	Writing log to file

Situations leading to errors during operation with registers are described in *Table 5.8*.

Table 5.8 Errors while working with registers

Function	Error name	Possible causes
MODBUS_READ_ HOLDING_REGISTERS	MODBUS_ILLEGAL_ DATA_ADDRESS	– number of requested registers is greater than the maximum possible number (125); – request for nonexistent parameter
MODBUS_READ_ INPUT_REGISTERS	MODBUS_ILLEGAL_ DATA_ADDRESS	– number of requested registers is greater than the maximum possible number (125); – request for nonexistent parameter

MODBUS_WRITE_ SINGLE_REGISTER	MODBUS_ILLEGAL_ DATA_ADDRESS	– attempt to write a parameter whose size exceeds 2 bytes;
		– attempt to write a parameter, access to which is denied;
		– attempt to write a parameter of this type, which cannot be written to by this function. Supported Types:
		  – signed and unsigned integers (max. 2 bytes);
		  – enumerated type;
		  – float16 (currently this type is not used for Module).
		– request for nonexistent parameter

Function	Error name	Possible causes
	MODBUS_ILLEGAL_DATA_VALUE	– value outside the parameter limits
MODBUS_WRITE_MULTIPLE_REGISTERS	MODBUS_ILLEGAL_DATA_ADDRESS	– writing of a nonexistent parameter; – attempt to write a parameter, access to which is denied; – number of writable registers is greater than the maximum possible number (123)
	MODBUS_ILLEGAL_DATA_VALUE	– no terminating character (\0) was found in the string parameter; – size of the requested data is less than the size of the first or last parameter in the request; – value outside the parameter limits

Situations leading to errors during operation with the log file are described in *Table 5.9*.

Table 5.9 Errors while working with the log file

Function	Error name	Possible causes
MODBUS_READ_FILE_RECORD	MODBUS_ILLEGAL_FUNCTION	– illegal data size (0x07 <= data length <= 0xF5)
	MODBUS_ILLEGAL_DATA_ADDRESS	– reference type does not meet specification; – could not open the file for reading (it may be missing)
	MODBUS_ILLEGAL_DATA_VALUE	– could not move to the desired offset in the file
	MODBUS_SLAVE_DEVICE_FAILURE	– file deletion error when deleting; – request too much data (more than 250 bytes); – illegal record number (more than 0x270F); – illegal record length (more than 0x7A)
MODBUS_WRITE_FILE_RECORD	MODBUS_ILLEGAL_FUNCTION	– illegal data size (0x09 <= data length <= 0xFB)
	MODBUS_ILLEGAL_DATA_ADDRESS	– reference type does not meet specification; – could not open file for writing
	MODBUS_SLAVE_DEVICE_FAILURE	– requested file is missing; – requested file is read-only; – failed to write the required number of bytes

5.6 Digital outputs operation modes

Only one additional operation mode can be switched on at one output.

– logic switching;
– low-frequency PWM signal generation;
– high frequency PWM signal generation mode (only for DO1–DO8 outputs);

– generation of the give number of pulses (only for DO1–DO3 outputs).

To select the mode and its settings, write the values to the corresponding Modbus registers (see *Section 5.5.1*).

5.6.1 Logic switching

The outputs in the logic state switching mode are controlled by writing the output status bitmask to the corresponding Modbus registers.

5.6.2 Low-frequency PWM signal generation

All Module outputs can operate in the mode of generating PWM signals.

To configure the mode, set the parameters:

– PWM period (1000 to 60,000 ms);
– PWM duty cycle (%).

5.6.3 High frequency PWM signal generation

The outputs DO1–DO8 can operate in the mode of generating high-frequency PWM signals.

To configure this mode, set the following parameters:

– pulse repetition rate (0 to 60,000 Hz);
– PWM duty cycle (%).

5.6.4 Generator of a given number of pulses

The outputs DO1–DO3 can operate in the mode of generating a given number of pulses.

Each output is controlled by writing the following parameter values to output control registers:

– number of pulses (from 1 to 65535);
– generation frequency (up to 60,000 Hz).

The generation of pulses will start after writing the number of pulses into the corresponding register. The duty cycle the signal is unchanged and equal to 50%.

In the register of the counter value of the pulse generator of a particular output, the number of pulses that are left to output to generate out of this output is stored.

To force the pulse generation to stop, it is necessary to write the value **0** into the register Counter value of the pulse generator.

5.7 Output switching modes

The Module outputs can operate in two switching modes:

– high-side switch (*Figure 5.2*), for switching loads with a smaller capacity and a large current;
– push-pull output (*Figure 5.3*), for switching loads with a higher capacity and lower current.

Two modes can not be simultaneously enabled on the same output.

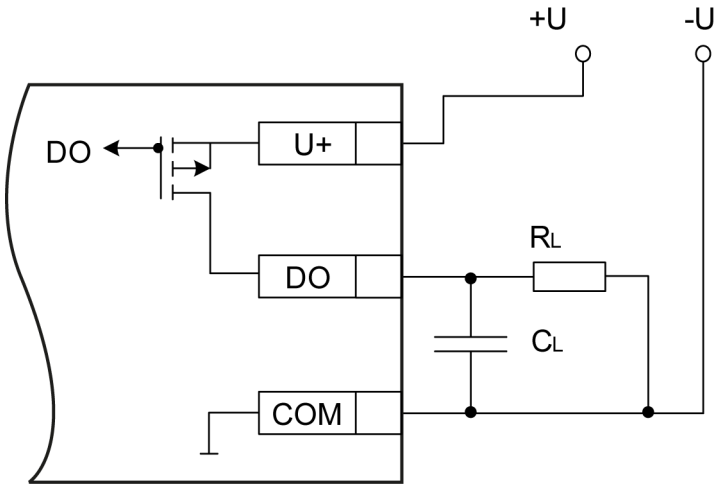

Fig. 5.2 Load connection in the high-side switch mode

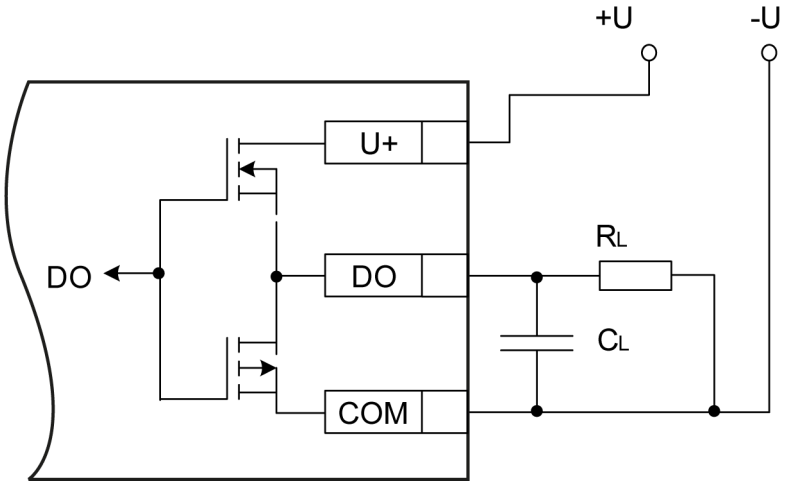

Fig. 5.3 Load connection in the push-pull output mode

NOTE
In the high-side switch mode, in order to increase the load current, it is allowed to connect the load in parallel to several outputs of the same group.

5.8 Output operation on the capacitive load

Module outputs can be connected to a capacitive load. Depending on the nominal value of the capacitance, restrictions are imposed on the maximum frequency and on the minimum pulse duration of the output signal.

5.8.1 Push-pull output mode

The minimum pulse duration at the outputs supply voltage of 24 V, depending on the resistive and capacitive loads, is given in *Table 5.10* below:

Table 5.10 Minimum pulse duration of the output signal in the push-pull output mode (µs)

Load resistance, R_L	Load capacity, C_L					
	0 pF	1000 pF	22 nF	50 nF	100 nF	1µF
250 Ω	1	1	2	4	10	—
500 Ω	1	1	3	6	20	80

Load resistance, R_L	Load capacity, C_L					
	0 pF	1000 pF	22 nF	50 nF	100 nF	1µF
5 kΩ	1	1	4	10	30	100*
* With a load capacity of 1 µF and a load resistance of 5 kΩ: – maximum pulse rise time is 10 µs, – maximum pulse decay time is 20 µs						

The maximum allowable frequency of the PWM at the outputs supply voltage of 24 V when operating at resistive and capacitive loads is given in *Table 5.11*:

Table 5.11 Maximum allowable PWM frequency (Hz)

Load resistance, R_L	Load capacity, C_L					
	0 pF	1000 pF	22 nF	50 nF	100 nF	1µF
250 Ω	60,000	50,000	14,000	6,000	3,000	200
500 Ω	60,000	60,000	31,000	13,500	6,500	500
5 kΩ	60,000	60,000	50,000	35,000	17,000	1 000

5.8.2 High-side switch mode

The minimum pulse duration at the outputs supply voltage of 24 V, depending on the resistive and capacitive loads, is given in *Table 5.12* below:

Table 5.12 Minimum pulse duration of the output signal in the high-side switch mode (µs)

Load resistance, R_L	Load capacity, C_L					
	0 pF	1000 pF	22 nF	50 nF	100 nF	1µF
50 Ω	10	10	15	25	40	—
500 Ω	10	10	30	50	400	1500
5 kΩ	10	20	300	500	5000	10000
* With a load capacity of 1 µF and a load resistance of 5 kΩ: – maximum pulse rise time is 10 µs, – maximum pulse decay time is 20 µs						

The maximum frequency of the PWM at the outputs supply voltage of 24 V when operating at resistive and capacitive loads is given in *Table 5.13*:

Table 5.13 Maximum PWM frequency (Hz)

Load resistance, R_L	Load capacity, C_L					
	0 pF	1000 pF	22 nF	50 nF	100 nF	1µF
50 Ω	10,000	1 000	650	400	250	—
500 Ω	10,000	1 000	300	200	25	5
5 kΩ	10,000	500	30	20	2	1

5.9 Output operation on inductive load

Module outputs can be connected to an inductive load. The module implements hardware protection against self-induction current that occurs during load shedding. An external protective diode connection is not required.

5.10 Diagnostics of outputs and loads

The Module outputs detect faults listed in *Table 5.14*.

Table 5.14 Diagnostics of output stage faults (outputs DO1–DO8, DO9–DO16)

Fault	Note
Malfunction of the entire output stage	
Overheating of the output stage	Diagnostics of the above malfunctions occurs regardless of the selected output stage mode and cannot be disabled. In case of detecting any of the faults, the entire output stage is switched off (DO1–DO8 or DO9–DO16)
Increased voltage in the output stage power circuit	
Malfunction of individual elements of the output stage	
Transistor output overheating	Diagnostics of the above malfunctions occurs regardless of the selected output stage mode and cannot be disabled. In case of detecting any of the faults, only the faulty output is switched off.
Overcurrent in load circuit	
Short circuit in the load circuit (only if the output state is **On**) *	
Load break	
Load break (only if the output state is **Off**)*	The load break diagnostics is enabled during the module setup and works only for the output in the high-side switch mode. The maximum load resistance, at which the load break diagnostics works, is 100 kΩ
NOTE * In the high-frequency PWM signal operation mode or with a small value of the PWM duty cycle, malfunctions may not be diagnosed	

When the fault is detected, the red output status LED lights up. The status of the outputs is written in the corresponding registers. The list of Modbus registers is given in *Section 5.5.1*.

NOTICE
For operation of the load interruption monitoring, a current of not more than 1 μA is always present in the load circuit.

5.11 Safe output status

A safe output status is possible for each output.

The output switches to the safe state, if at the time of turn-on or during the time-out time there are no commands from the Network Master. The value of the **Safe status** is set in percentage (from 0 to 100%) at the module output. This value determines the duty ratio of the PWM.

Time-out is set by user. If the time-out is set to **0**, safe output state is off. When the Module is switched on, it will go into the state that was last set before shutdown, and will remain in it until a new command is received from the Network Master.

NOTE
The factory setting for **Safe state activation timeout** is activated is **30 seconds**.

6 Configuration

6.1 Connection to akYtec Tool Pro

The Module is configured in the akYtec Tool Pro program.
The Device can be connected to a PC using the following interfaces:
– USB (microUSB),
– Ethernet.
To select an interface:

1. Connect the module to the PC using a USB cable or Ethernet interface.

NOTICE
If the module is connected to the USB port, the main module power supply is not required.
If the Module is powered with USB, the outputs do not function.
In case of connecting via Ethernet interface it is necessary to supply the main power to the module.

2. Run akYtec Tool Pro.
3. Click the icon **Add devices** on the tool bar.
4. In the drop-down menu "Interface" select:
   – Ethernet (or other network card to which the module is connected): for Ethernet connection;
   – STMicroelectronics Virtual COM Port: for USB connection.

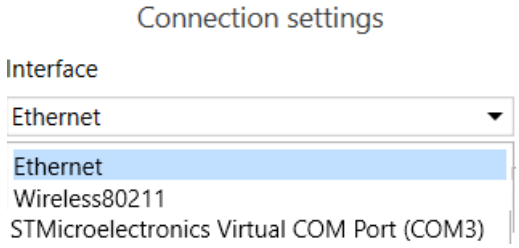

Fig. 6.1 Interface selection menu

The next steps for finding a Device depend on the choice of interface.
To find and add a Device connected to the Ethernet interface to the project:

1. Select "Find device"
2. Enter IP-address of the connected device.
3. Click Find. A Module with the specified IP address is displayed in the window.

NOTICE
The default IP address (factory setting) is **192.168.1.99**.

4. Select the Device (place a check mark) and click OK. If the Device is password protected, you must enter the correct password. The Device will be added to the project.

To find and add a device connected via USB interface to the project:

1. In the drop-down menu, select the akYtec Auto Detection Protocol.

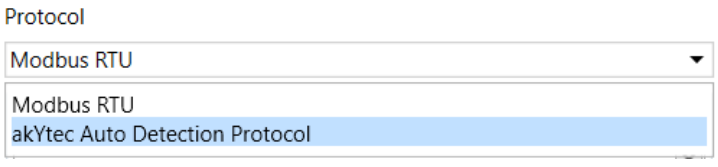

Fig. 6.2 Select Protocol

2. Select **Find device**.

3. Enter the address of the connected device (default is **1**).
4. Click **Find**. The module with the specified address is displayed in the window.
5. Select the device (place a check mark) and click OK. If the device is password protected, you must enter the correct password. The device will be added to the project.

For more information on connecting and working with Devices, see the AkYtec Tool Pro Help. To call help in the program, press **F1**.

6.2 Configuring Network Settings

The parameters shown in the table must be set for the Module for Ethernet connection:

Table 6.1 Module's network parameters

Parameter	Note
MAC-address	Set at the factory and is unchanged
IP address	Can be static or dynamic. The factory setting is **192.168.1.99.**
Subnet mask	Specifies the subnet of the IP addresses of other devices visible by the Module. The factory setting is **255.255.255.0**
Gateway IP Address	Specifies the gateway address to access the Internet. The factory setting is **192.168.1.1**

The IP address can be:

Static. This IP address is set using the akYtecToolPro program or the Service button.

To set a static IP address using the akYtecToolPro, proceed as follows:

1. Click on the line **Connection Settings** in the parameter field.
2. Select the **Ethernet settings**.
3. Specify new values for fields **Enter IP Address**, **Enter Subnet Mask** and **Assign gateway IP address**.
4. Set **DHCP Mode** to **Off**.
5. Click on symbol “Save data” in the menu bar.

With help of service button, you can set IP addresses immediately for the group of Modules.

To assign IP address using service button:

1. Connect a module or group of Modules to an Ethernet network.
2. Start the akYtecToolPro program on a PC connected to the same Ethernet network.
3. Click on symbol "IP addresses" in akYtecToolPro program.
4. Enter IP address for the first Module or Module group.
5. Push the service buttons sequentially on the Modules, monitoring the result in the program window. In this case, the information about the Module on which the button was pressed will be displayed in the program window, this Module will be assigned a specified static IP address and other network parameters. The program automatically increments the address by 1.

NOTICE
If the IP address assignment with service button does not work, set the **DHCP mode** to **One-off setting with service button** in the akYtecToolPro program (default setting).

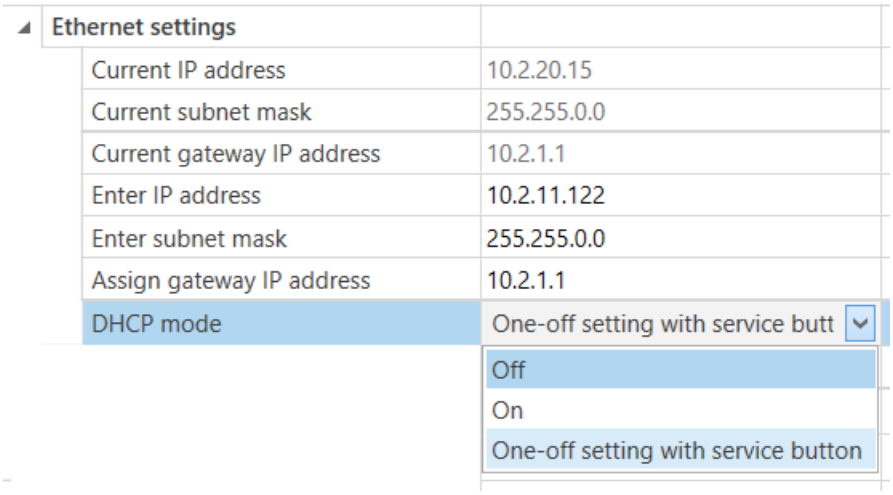

Fig. 6.3 DHCP mode settings

Dynamic. A dynamic IP address is used to work with the cloud service (not available yet) and does not imply working with the Modbus TCP Master. The IP address of the Module is set by the DHCP server of the Ethernet network.

CAUTION
Check with the system administration services if there is a DHCP server in the network area to which Module is connected. If using a dynamic IP address, you must enable the DHCP mode.

NOTICE
To use the new network settings, you need to restart Module. If the module is connected via USB, it must also be disconnected.

6.3 Module access password

To limit access to read and write configuration parameters, a password is used.
You can set or change the password when configuring using the akYtec Tool Pro.
If the password is lost, the factory settings must be restored (see *Section 6.6*).
By default, the password is not set.

6.4 Firmware update

Firmware can be updated by the following ways:
– by using the USB interface;
– by using Ethernet (recommended).
To update via USB, follow the steps:

1. When the Module is powered on, press and hold the service button. The Module will enter the downloader mode.
2. Update the software with a special utility. The utility is available at www.akytec.de.

To update via Ethernet, follow the steps:

1. In the akYtec Tool Pro, click on **Firmware update**.
2. Follow the program's instructions (the firmware file is available on www.akytec.de);
3. Restart the Module.

During the update via Ethernet, the integrity of the firmware file and the checksum are checked.

NOTICE
A restart of the Module is required to complete the update. If the Module is connected via USB, it must also be disconnected.

6.5 Real-time clock setting

The real-time clock (RTC) can be set or read from the Module via Modbus registers and also using the akYtec Tool Pro program (see the program help).

To set a new time via Modbus registers:

1. Write the time value in the appropriate registers.
2. Set the value **1** in the current time update register for at least 1 second.
3. Write the value **0** in the current time update register.

The next writing of the current time can be made after 1 second.

6.6 Restore default settings

CAUTION
After restoring the factory settings, all previously configured settings, except network settings, will be deleted.

To restore the factory settings and reset the installed password:

1. Switch on the power.
2. Press and hold the service button for more than 12 seconds.
3. Switch off and switch on the Device.

After turning on, the Device will work with default settings.

7 Maintenance

7.1 General Instructions

During the maintenance work on the Device, the safety requirements must be considered.
Maintenance of the Device is carried out at least once every 6 months and includes the following procedures:

– checking the Device mounting;
– checking the screw connections;
– removal of dust and dirt from the device terminal block.

7.2 Battery replacement

A replaceable CR2032 type battery is used to power the real-time clock.
Replace the battery if at least one of the following events occurs:

– LED Fault blinks (it lights for 200 ms with a 3 second interval).
– The last battery change was 6 years ago.

To replace the battery:

1. Power off the module and all connected devices.
2. Remove the module from the DIN rail.
3. Raise cover 1.
4. Remove two screws 3.
5. Remove the terminal block 2 as shown in *Figure 7.1*.

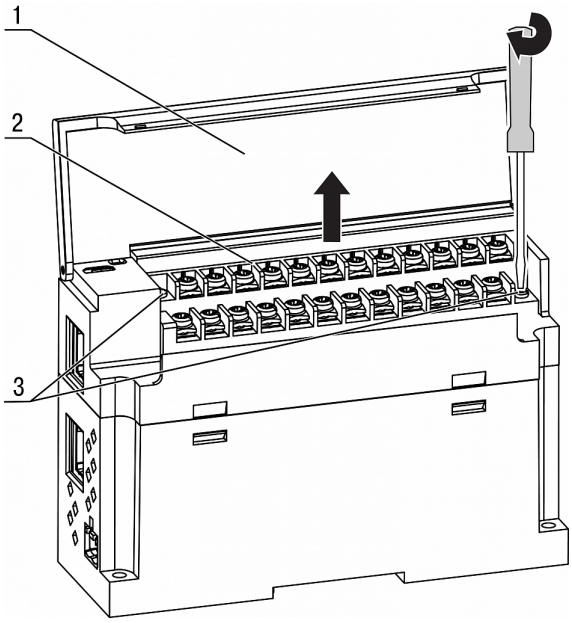

Fig. 7.1 Remove terminal block

6. Alternately remove the hooks from the holes on one side and on the other side and remove the top cover.

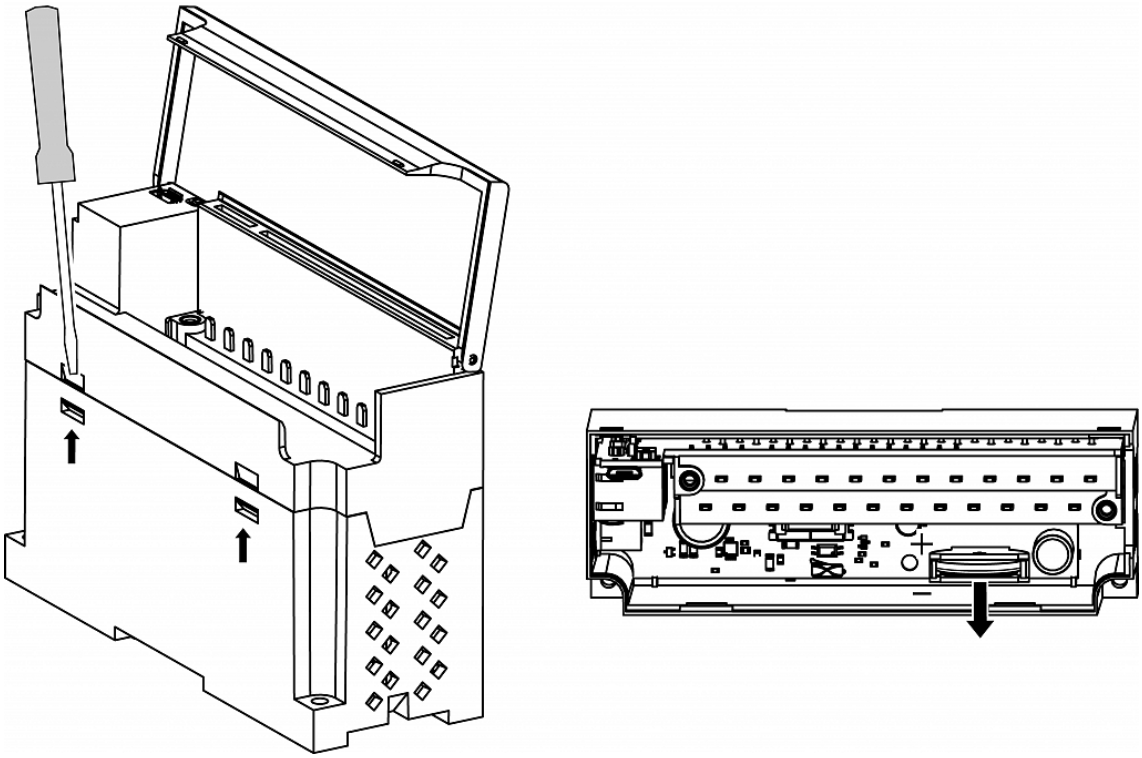

Fig. 7.2 Battery replacement

7. Replace the battery. Recommended time for replacing the battery is not more than 1 minute. If the battery is missing for a longer time, the real-time clock must be set up again.
8. Assembly and installation should be carried out in the reverse order.

NOTICE
Do not use a different type of battery. When installing the battery, observe the polarity.

After Module is assembled and turned on, make sure that the system time is correct. If necessary, configure the real-time clock in the akYtecToolPro program.

When loosing the fastening screws, the terminal block rises, so it is recommended to unscrew the screws by turns several turns at a time.

8 Transportation and storage

Device must be transported in closed transport of any kind. The fastening of containers during transport should be carried out in accordance with the rules applicable to the respective modes of transport.

The transport conditions must be in accordance with IEC 61131-2-2012 at ambient temperature from – 40 to + 55 °C in compliance with the protection measures against impacts and vibrations.

Transportation should be carried out in a shipping container individually or in over-packs.

The storage conditions in the packaging at the manufacturer's and consumer's warehouse must comply with IEC 61131-2-2012. In the air no aggressive impurities must be present.

Device should be stored in the racks.

9 Scope of delivery

Denomination	Quantity
Device	1 unit
Short guide	1 ex.
UTP patch cable 5e 150 mm	1 unit
Power supply terminal 2EGTK-5-02P-14	1 unit
Ethernet connector plug	1 unit

NOTICE
The manufacturer reserves the right to introduce amendments to the scope of delivery.

Appendix A Encrypting the log file

When decrypting the log file, a hash function should be used as the initialization vector. The hash function returns 8 bytes (type long long).
An example implementation of a hash function in C:

```
typedef union {
        struct {
                unsigned long lo;
                unsigned long hi;
        };
        long long hilo;
}LONG_LONG;

long long Hash8(const char *str) {     // Based on Rot13
        LONG_LONG temp;
        temp.lo = 0;
        temp.hi = 0;

        for ( ; *str; )
        {
                temp.lo += (unsigned char) (*str);
                temp.lo -= (temp.lo << 13) | (temp.lo >> 19);
                str++;
                if (!str) break;
                temp.hi += (unsigned char) (*str);
                temp.hi -= (temp.hi << 13) | (temp.hi >> 19);
                str++;
        }
        return temp.hilo;
}
```