

PROGRAMMABLE LOGIC CONTROLLER WITH GSM COMMUNICATION MAX H04



USER MANUAL

Document Version U6.1 [170731]

[firmware version 06.11]

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PURPOSE

The MAX H04 controller is a freely programmable logic controller with built-in GSM communication. It is designed to solve a wide range of tasks of managing technological processes and data exchange via GSM mobile network in SMS, VOICE and CLIP modes. The controller is used in home automation as operating conditions monitor and remote control as well as part of control and supervision solutions in industrial automation equipment of small and medium scale.

MAX H04 is one of the few devices that allows you to connect and use it without programming. Thanks to the special configuration program H04Config, it can be used by anyone who does not want to learn languages and complicated programming procedures of PLCs.

WARNING!

The MAX controller works in GSM 900/1800 mobile network of any operator in Poland (no simlock lock). One of the basic requirements for using a GSM communicator is the existence of a suitable infrastructure. In order for the device to make calls and perform the required functions, it must have an active SIM card that allows to perform communications services with the selected operator.

PROGRAM TOOLS

For the internal tasks and user program interpretation in ForthLogic language is responsible hardware and software system called forth-system. The computational model underlying ForthLogic language consists of stacks, global variables, a dictionary, an input and an output buffers. ForthLogic allows you to describe processes running parallel and functioning in a multi-tasking environment.

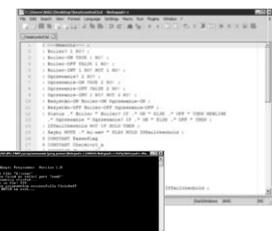
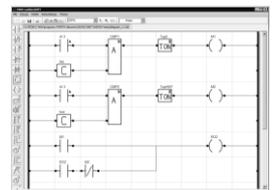
The interactive programming and application development environment for MAX ForthLogic language consists of the Notepad++, the PuTTY terminal program, and the ForthLogic programming tool. The environment allows you to create scripts in ForthLogic, program MAX controller, and communicate with the controller in terminal mode.

MAXLadderSOFT allows you to easily convert the "relay" scheme into the programming language of the controller. The program allows you: creating and editing applications using the Ladder Diagram Language [LAD]; validation of the schematic design; direct communication between the controller and the computer; uploading the application to the controller memory.

Direct work with the forth-system is called the dialog mode. There are two types of dialog mode: terminal and remote. Terminal mode is the operation with the HIPERTERMINAL program (MAX-PC connection via USB cable). Terminal mode is primarily used in programming, solving programming tasks or solving problems in the controller. Remote mode - only for controller with GSM module - it is the work with the phone via SMS. In this mode, the phone screen performs similar functions as the terminal window on the computer monitor. The remote mode is obviously used for remote control of devices connected to the controller.

The MAXTool service program allows you to set controller parameters, upload firmware and Forth applications, open graphical extensions and direct communication in a simplified terminal mode.

The H04Config program allows you to connect and use the controller without programming components. The program can be used by anyone who does not want to learn languages and complicated programming procedures for PLCs.



LED SIGNALING

The controller has three LEDs:

- the green LED "POWER" shows the power supply of the communicator;
- the yellow LED "STATUS" shows the status of the GSM modem. In normal state, the LED is constantly on. No light indicates the modem is faulty or damaged.
- the red LED "GSM" is designed to indicate the operation of the GSM module within the GSM network. The "GSM" LED indicates the various states and modes of operation of the GSM module:
 - pulsation with pause time of 0.8sec - the module does not log on to the operator network or problems with the SIM card have occurred;
 - pulsation with pause time of 3sec - correct login, GSM network available.

OPERATING MODE

The controller may function as a device with a rigid work algorithm, the parameters and functions are set by using H04Config, or as a freely programmable logic controller, control logic of which is entirely defined by the application (ForthLogic language program or MAXLadderSoft program).

SD CARD

The SD/MMC memory card reader can perform service functions and record and store recorded data (external non-volatile memory). Supports SD, SDHC and MMC memory cards up to 32 GB, formatted by FAT32 file systems.

INTERNAL STORAGE

The built-in non-volatile memory with a capacity of 2 MB is designed to store the recorded data.

DATALOGGER

STARTING

The built-in datalogger can be activated via the configuration program H04Config or using fixed words of ForthLogic language. Once activated, the registration starts automatically after each time the controller is started.

OPERATION

The datalogger allows you to save data in two modes:

- Interval mode - the data are stored in an equal, fixed intervals;
- event mode - the data are stored on the occurrence of any changes in the logical I/O or communication event through the GSM network (voice, SMS).

Datalogger file is kept on the SD card

WARNING!

With data logging, the controller must have an SD card. In the absence of SD card, data will not be saved.

WARNING!

Sudden loss of power when writing data to a datalogger file may result in a partial file damage or total loss. It is therefore advisable to use an external battery as a backup power source when logging data.

DATALOGGER INDICATORS

The data logging process is signaled in the middle of the time bar by an animated red rotary mark .

DATALOGGER STRING FORMAT

When logging data, they are stored in the form of text strings in the file "datalog.txt." Data string has the following format:

```
<time> <date> | 1AI 2AI 3AI 4AI | 1DI 2DI 3DI 4DI 5DI 6DI 7DI 8DI | 1DO 2DO 3DO 4DO | 1RO 2RO 3RO | BAT POW
```

AI - actual values (scaled) of analog inputs

DI - state of digital inputs

DO - state of digital outputs

RO - status of triac outputs Q

BAT POW - backup power supply and main power supply

Example:

2017-03-23 13:04:39 | 18.4 22.0 0.0 0.0 | 0 0 1 0 0 0 0 1 | 1 0 0 0 | 1 1 0 | 12.3 24.1

Each event is saved with the appropriate SMS text. Example:

2017-3-23 17: 39: 3 "DIAI1 high is activated!"

CLOCK

WARNING!

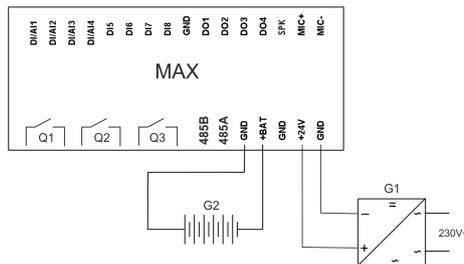
The system clock does not have an internal power supply, so you must use the battery to maintain the real time clock. The controller has an automatic summer/winter time change feature that can be switched off.

The first time you turn on the controller, set the time and date in the Configuration Menu of the MAXTool.

Daylight savings time is indicated by the blue letter S before the date in the time bar. In order to increase the accuracy of the system clock, it is possible to set the automatic time correction in seconds using the MAXTool. System time correction is performed on the first day of each month at 21:00:00 by adding the adjusted value to the system time.

SUPPLY

The built-in power supply and battery charger allow a flexible power scheme. For many functions of the controller it is required to use emergency power (backup) in the form of an external gel battery with a nominal voltage of 12V. The controller constantly monitors the battery charge status and charges it automatically when the main voltage is present.



WARNING!

Before using the battery with the controller, the battery must be fully charged according to the manufacturer's instructions!

ACCESS LOCK

It is possible to set a password that protects access to the system via terminal and SMS commands.

The password is a 4 to 15 digit string set in the MAXTool, in the H04Config program or through the ForthLogic commands.

WARNING!

If the password is lost, the only way to access the communicator is to reinstalling the firmware.

REMOTE CONTROL AND NOTIFICATION

The remote control function allows you to directly manage the outputs and control the status of the devices connected to the controller inputs via the mobile phone.

VOICE MENU

IVR voice commands (playable .wav sound files) allow remote control in standard voice call mode using DTMF (select the desired option by pressing the phone keypad). When creating a program in ForthLogic, you can create any voice menu based on your individual needs, eg: "Boiler control 1, heating control 2, group control 3, system state 4".

SMS COMMANDS

SMS commands are standard ForthLogic commands that are known to the forth-system and are directly implemented by the controller.

As such, it is possible to provide any command word from the standard ForthLogic dictionary, which will be directly executed by the controller, eg "1 1 RO!". Such word with parameters will set output relay 1 to active state. After the command is executed, we will receive a "(OK)" return message. In case of giving a command unknown to the forth-system, we will receive the message "ERROR - UNKNOWN WORD".

When creating a program in ForthLogic, based on the individual user's needs, you can create arbitrary commands of any syntax, for example "START", "STATUS", "PUMP?", etc. Such commands carry out the proper operations referred in the words of the ForthLogic language.

NOTIFICATION

The notification function allows you to receive instant SMS information on the user's telephone about change in state of the digital or analog inputs, change the operating parameters of the system, etc. SMS content is standard system messages or special user defined phrases, eg "Warning, main power supply blackout".

STATUS I/O

Enter the status screen by long pressing the MENU button.

The status screen of the inputs and outputs allows for instant orientation in the controller operating status, informs about firmware version, available memory and power supply parameters.



□ Version: - firmware version number.

■ Free memory:

- Logger is the number of free internal datalogger memory in kilobytes;
 - Forth is the number of free memory for ForthLogic applications in bytes.
- Memory value are listed under the their designations.

■ AI: - status of analog inputs (if set up). The top line displays the input number. The bottom line displays the current input value in units of the controller ADC (0 ÷ 1024).

■ DI: - status of digital inputs (if set up). The top line displays the input number. The bottom line displays the current state of the input (0 - passive, 1 - active).

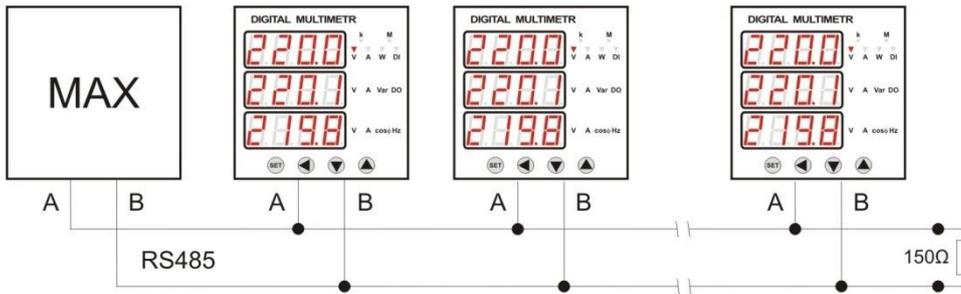
■ DO: - status of digital outputs. The top line displays the output number. The bottom line displays current output status (0 - passive, 1 - active).

■ RO: - status of relay outputs. The top line displays the output number. The bottom line displays current output status (0 - passive, 1 - active).

■ POWER: - The top row shows the power supply names: +24 - main power; +BAT - backup power (battery). The bottom line shows the values of these voltages accordingly. If the operation of the controller with backup power is selected in the configuration menu and if the battery is not connected at +BAT terminal, the charging voltage at the output will be indicated.

COMMUNICATION PORT RS-485 and MODBUS RTU PROTOCOL

The controller has the ability to exchange data with external devices via RS485 interface using the MODBUS RTU protocol. (terminals marked 485A and 485B)



Communication parameters of the controller:

Operation Type: MASTER

Bits per second: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200

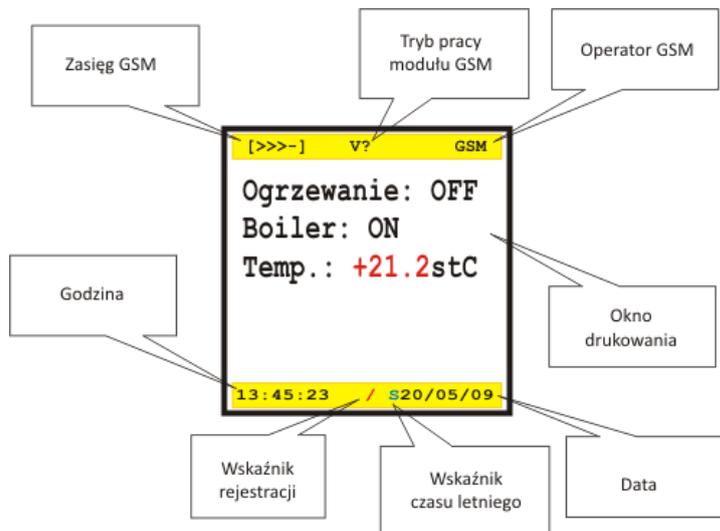
Data bits: 8

Parity: none/even/odd

Stop bits: 1/2

LCD SCREEN

The screen is divided into three parts (see fig.). In the upper part there is the GSM status bar, where the GSM signal strength and operator name are displayed. In the middle there is a printing window where you can see the corresponding messages from the controller application (this option is only available in case of ForthLogic programming). At the bottom there is a time bar showing the controller's time and date and the status of the datalogger: / - the status of the datalogger (status is an animated, rotating red line) or L - information about non-empty datalogger file in the controller memory. S - signals daylight saving time.



Turn off the display is done by pressing the **Esc** key.
Switching display on is done using the **Menu** button.

GSM STATUS

On the left hand side of the upper bar, the GSM signal level is displayed, as is in case with most cell phones, with four right angle characters (">>>>"), indicating the maximum signal strength, and four bars ("[- ---]" indicating a lack of signal. In the middle of the upper bar the GSM module link mode is displayed:

- "S?" received a new SMS message, with an audible signal at 1661 Hz, lasting 100 ms;
- "SI" sends an SMS message from the controller, with an audible signal at 830 Hz, lasting 100 msec;
- "?V" received the incoming voice call to the controller, with periodic audible signal at 369 Hz, lasting 1 sec;
- "V?" initiates the voice call by the controller;
- ">V" taken an incoming voice call to the controller;
- "V>" taken outgoing voice call from the controller.

The right side of the upper bar shows the name of the operator of the available network.

KEYBOARD

KEYBOARD

The controller keyboard is used to navigate menus and to enter parameter values. Each press is accompanied by an audible signal at 2000 Hz, lasting 30 msec.

BUTTONS

Menu - switching display on / entry to text menu / entry to the status of I/O (long press)

◀△▽▶ - moving cursor

OK - accept the selected option or set parameter

Esc - exit the text menu / resignation of the selected option

F1 / F2 – special options

DATA ENTERING

When entering a parameter value, move the cursor by ◀▶ (move to the next character position). The **F1** key gives you the option to select a set of symbols from the sets: [S] punctuation, math, and other characters, [D] digits, [P] uppercase Latin, [p] lowercase Latin. The selection of the active symbol set is indicated in the upper left corner of the input window (on a blue background). Use the keys △▽ to browse symbols from the selected set. The space at the cursor position can be set using the **F2** key (the same character as for first character of [S] set). Entered string is accepted by the button **OK**. Exit without changes is performed by the button **Esc**. The edited position is highlighted in pink.



INSTALLATION AND OPERATION

- Read the manual carefully before using the controller.
- The controller should be installed, operated and programmed by qualified personnel familiar with its construction, operation, and associated hazards.
- Do not install a device that is damaged or incomplete.
- The user is responsible for the proper grounding of the system, the proper selection, installation and operation of other devices that cooperate with the controller, including safety devices.
- Before connecting the power supply, make sure all wires are connected correctly.
- Absolutely observe the operating conditions of the controller (supply voltage, humidity, temperature).
- To avoid electric shock or damage to the controller, always turn off the power supply whenever you change the connection.
- Do not make any changes to the unit yourself. This may damage or impair the operation of the controller or the control system, which could lead to damage to the control equipment and the risk to the operator. In such cases the manufacturer shall not be liable for any results and may refuse to grant the warranty for the controller in case of complaint.

RECOMMENDATIONS DURING ASSEMBLY

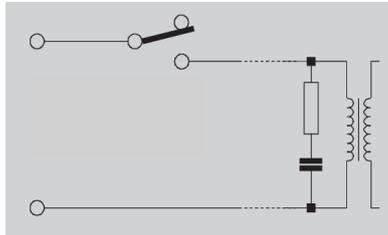
The controller is designed to work safely in both domestic and industrial environments. However, if the level of interference in your environment (eg switchgear) is too large or unknown, follow the following guidelines when installing the controller:

- Use an anti-interference filter and surge suppressor for the power supply (mains side) of the controller.
- Shield for power cables, sensor wires and input signal cables are recommended.

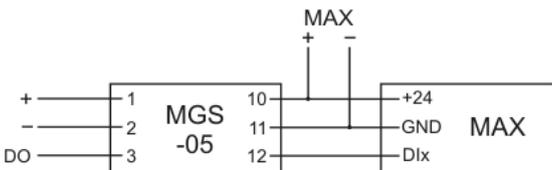
- Ground shields only in one place as close as possible to the controller.
- Do not route signal cables near and along the power line or other conductors of high currents.
- UTP cables (so-called twisted pair) are recommended as signal cables.
- Do not install the controller in direct proximity to high current receivers, other electromagnetic devices with phase regulation or control of current and other devices capable of producing strong electromagnetic impulses.

PROTECTION BEFORE INTERFERENCE

In case of disconnecting the internal contact of the relay on which the inductive load circuit (coils of other relays, contactors, etc.) is connected, sparks may emit electromagnetic pulse. These emissions have a negative impact on the operation of equipment and, in particular, sensitive microprocessor devices such as the controller. Other effects include reduced switching life of the relay contacts and the degradation of semiconductor components (diodes, transistors, etc.), creating an obstacle to the operation of the control or measurement systems with the potential for possible damage. The easiest way to avoid these effects is to attach the interference protection module to the circuit. Modern relays have built-in security features. You can also use a RC filter with a $47\Omega / 1W$ resistor and a $22nF / 630V$ capacitor (see figure) as a possible solution for switching on and off the mains (230V). This filter is best to connect directly to the inductive element of this circuit. This reduces the risk of sparking the contact and the likelihood of damage (burning).



Use the MGS-05 module to isolate the controller inputs from external signals. This module secures the digital inputs of the controller by introducing a galvanic isolation that protects the controller inputs from overvoltages min. 2500V. In addition, the module inputs are equipped with a RC filter to effectively eliminate impulse noise shorter than 2ms. By separating the power input of the module from the controller power supply, it is possible to separate the controller's power supply from the rest of the circuit, thus eliminating the possibility of transferring the noises from the automation power supply to the controller.



HARDWARE CONFIGURATION

ANALOG-DIGITAL INPUTS

Before installing the controller, configure the AI/DI1 ÷ AI/DI4 universal inputs. Select the input type: analog or digital. To do so, unscrew the four screws in the corners of the lower cover of the controller and remove the cover itself. Then unscrew the two diagonal screws that hold the upper PCB and, by catching the terminal blocks, lift the plate upward by removing it from the inner connector. On the lower side of this board there are groups of configuration pin switches, marked on the drawing according to the universal input that they configure (see figure).



Placing and numbering of configuration pin switches

For each pin switch, set jumper settings according to the entry type. The table shows the position of the pin switch contacts that must be closed with a jumper to set the desired input type.

Input type DI /AIx	Jumper 1	Jumper 2
Digital	3-5	4-6
Analog - current (4 ÷ 20mA)	1-3	2-4
Analog - voltage (0 ÷ 10V)	1-3	4-6

After setting, insert the board into the connector, fix it with two screws, place the cover and fix it with four screws.

WARNING!

Remember also to program the input type setting in the MAXTool program.

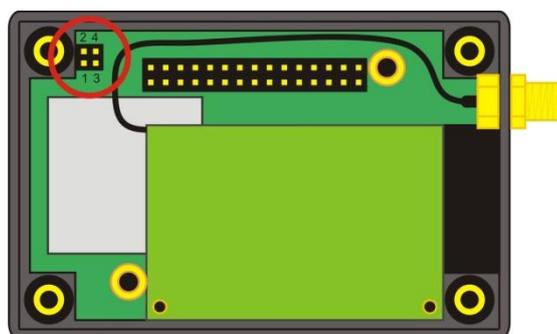
SPK OUTPUT

The SPK linear output is a standardized analog output that transmits sound from the audio channel of the controller without any signal processing.

The audio channel of the controller, depending on its hardware configuration, can operate in two modes: GSM audio and SPEAKER audio. GSM mode is the output of the GSM module audio channel during the voice call. SPEAKER mode is the output of the audio channel of the controller itself.

Select the output mode: SPEAKER or GSM. To do so, unscrew the four screws in the corners of the lower cover of the controller and remove the cover itself. Then unscrew the two diagonal screws that hold the upper PCB and, by catching the terminal blocks, lift the plate upward by removing it from the inner connector.

On the upper left side of the lower plate is a configuration pin switch (see figure).



Location and pin numbers of the SPK output pin switch.

Make jumper settings of the output mode. The table below shows the position of the pin switch contacts that must be closed with a

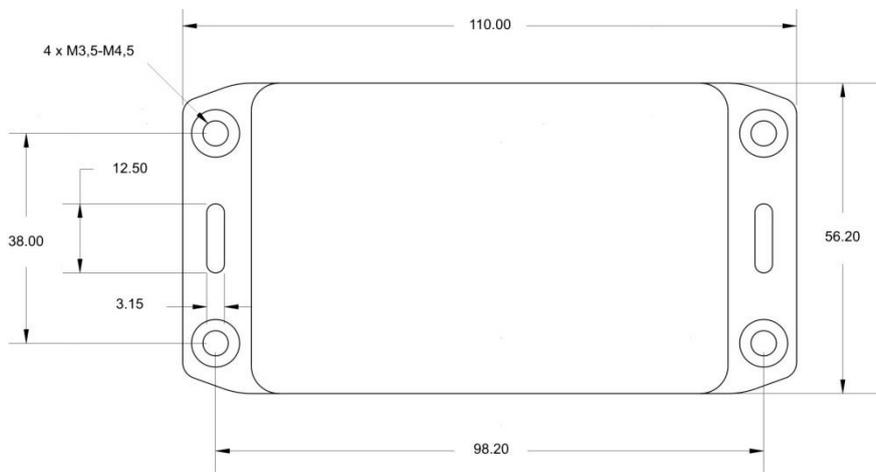
jumper to set the desired output type.

Output audio mode	Jumper
SPEAKER	1-2
GSM	3-4

After setting, insert the board into the connector, fix it with two screws, place the cover and fix it with four screws.

ASSEMBLY

Fix the controller to the flat substrate using 4 round holes or 35mm rail using 2 longitudinal vertical holes located on the controller's "ears".



Dimensions of the controller and mounting holes

ACCESSORIES

SIM CARD + ANTENNA

Remove the drawer from the SIM port by pressing the yellow button on the right side of the port with a thin object (eg pen). Place the SIM card in the drawer as indicated (upwards). Slide the drawer into the port. Screw the antenna.

SIM CARD RECOMMENDATIONS

SIM card for the controller:

- * Recommended SIM card with the so called "Telemetry / M2M". Ask your GSM operator.
- * The first activation of the SIM card should be on any mobile phone (send an SMS or make a voice call).
- * Clear the inbox memory.
- * Deactivate the PIN access code. In the case of an active PIN, the controller will not log in to the operator's network and this will prevent communication. Deactivate PIN code with any mobile phone.
- * For normal (not telemetry) tariffs, it is recommended to disable any additional operator services assigned to the SIM card, such as free SMS notifications, voice mail, IVR operator voice menus for free notifications.
- * It may take up to a few minutes to initialize the SIM by the controller. This is due to the registration of an unknown model of the device and the proper configuration of the system by the operator.

User's phone SIM:

- * Text input mode set to TEXT (not UNICODE)! By default, GSM operators set the TEXT mode. In case of ignoring the SMS by the controller, check those the settings and change to the correct one.

MICROPHONE

Connect the electret microphone to terminals MIC+ and MIC-. It allows you to listen "live" during a voice call.

Function is available only for user ForthLogic applications.

EXTERNAL SPEAKER

Connect the external loudspeaker through an amplifier to analog audio signal on controller`s terminals SPK and MIC-. The controller software functions allow playback of audio files (.wav) (SPEAKER audio mode) or listening external audio of the GSM channel in the direct voice connection mode (GSM audio mode).

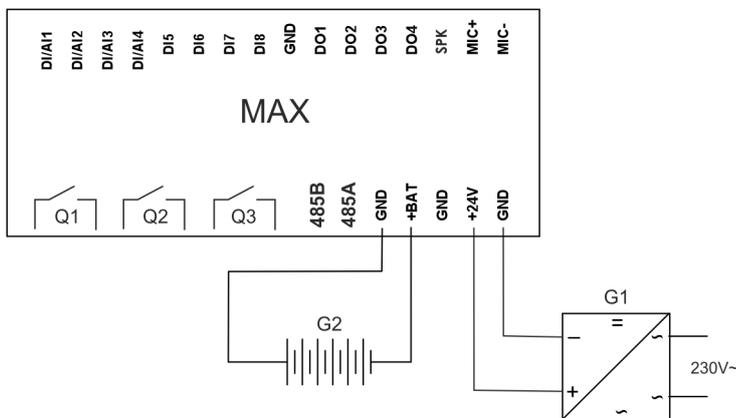
Function is available only for user ForthLogic applications.

DESCRIPTION OF INPUT/OUTPUT

Contact name	Purpose
DI/AI1÷DI/AI4	Combined universal inputs for connection of digital signals, analogue current signals (4 ... 20 mA), or analogue voltage signals (0 ... 10 V)
DI5÷DI8	Digital inputs.
DO1÷DO4	Digital outputs
Q1÷Q3	Triac electronic relay outputs, type 1Z (NO). WARNING! Only for AC currents!
MIC+, MIC-	Electret microphone input (capacitive)
SPK, MIC-	Line-out audio
DP, DN	RS485 serial port
+BAT	Contact for rechargeable battery +12V
+24V	Contact for connecting the main power supply
GND	Contacts for connecting the common cable to the inputs, outputs, RS485 serial port, power supply and battery

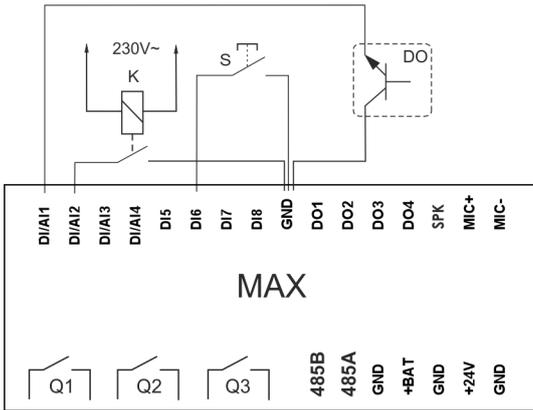
IMPLEMENTATION OF CONNECTIONS

SUPPLY



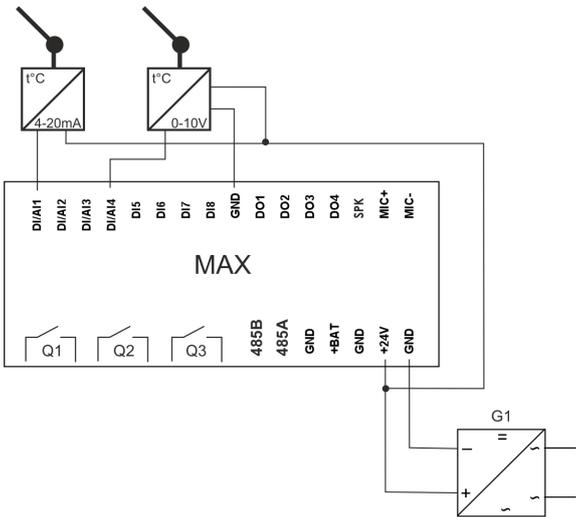
G1 - power supply DC
 G2 - gel battery 12V

DIGITAL INPUTS DI

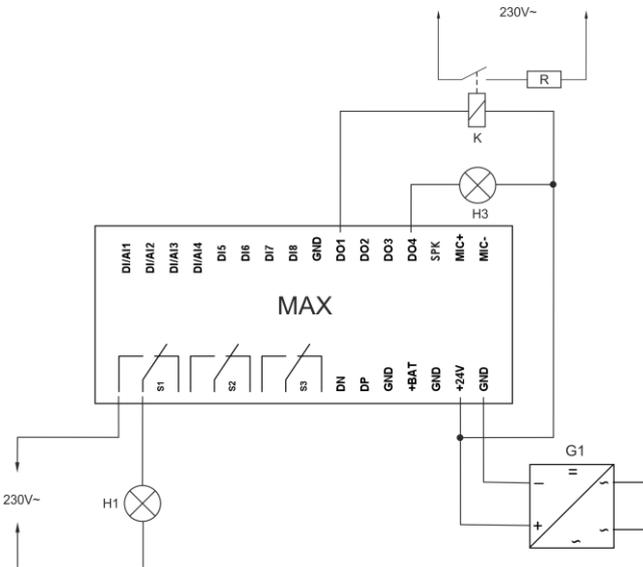


K – electromagnetic relay with isolated contact
 S – NO-contact button
 DO – digital output

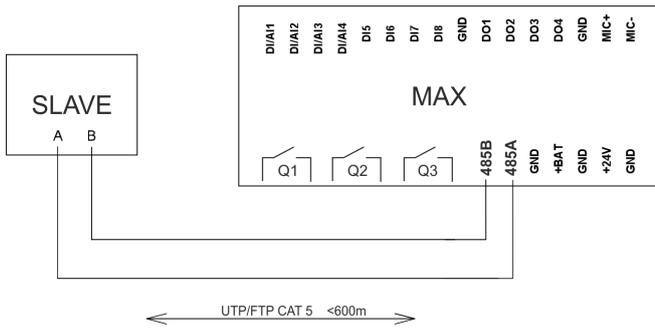
ANALOGUE INPUTS AI



DIGITAL OUTPUTS AND RELAY OUTPUTS



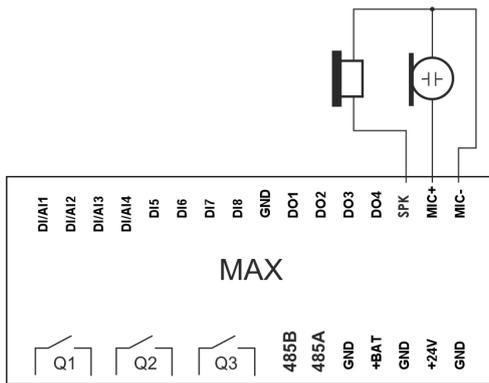
COMMUNICATION PORT RS-485



N1 - master controller
 H1 - slave device

Default controller communication parameters:
 Number of bits per second: 9600
 Data bits: 8
 Parity: none
 Stop bits: 2

SPEAKER AND MICROPHONE



COMMUNICATION WITH PC

The controller is compatible with a PC running Windows 2000, Windows NT, Windows XP, Windows Vista, Windows 7, Windows 8, Windows 10.

For connection is used USB-miniUSB cable.

WARNING!
 Install the distribution folder on your computer at a location where the path will not contain spaces, such as local disk D or system disk C (D:\MAXfolder\MAXTool).

You need to install a USB driver first. To do this, run the CDM20802_Setup.exe file from the usb folder. After installing the USB driver,

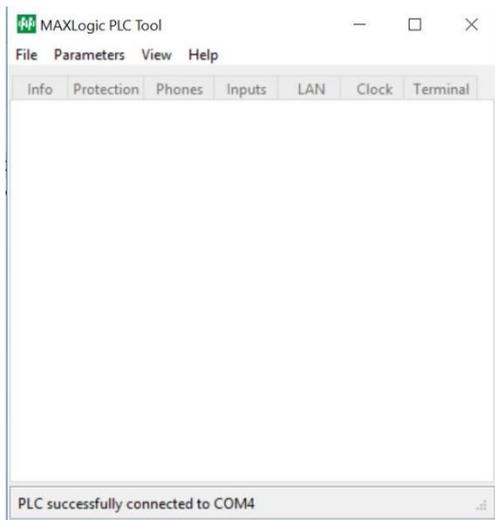
connect the controller to any USB port using a cable. It may take up to 1 minute to establish a connection and assign a port.

Each physical cable connection and software driver recognition is signaled by the controller with single beep sound.

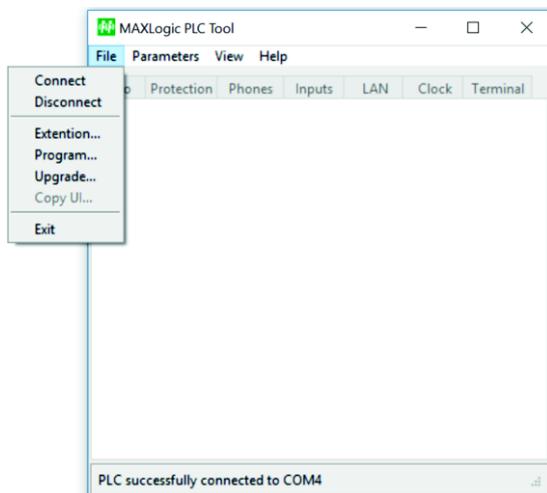
MAXTool - SERVICE PROGRAM

Run the MAXToll.exe file.

The program window opens. Connection to the PLC is indicated by the message "PLC succesfully conected to COMx". In the absence of communication with the controller, the window will be empty and the message "PLC not fund" will appear in the bottom bar.



TOOLBAR



File:

Connect - Connection to the controller

Disconnect - Disconnection from the controller

Extension - Upload a Tcl/Tk application wich will extend MAXTool with an additional menu window to work with your application. Specify a .tcl file. Extra window will be opened in the View tab.

Programm - ForthLogic application upload. Specify a .txt or .fl file

Upgrade - Upgrade firmware (file esfl-h04cnf.bin from folder Firmware). The previous settings and user application will be deleted.

Copy UI - Copy UI for software version 06.08.

Exit - Close the program

Parameters:

Read - Read and show the current controller settings

Write - Save new controller settings

View:

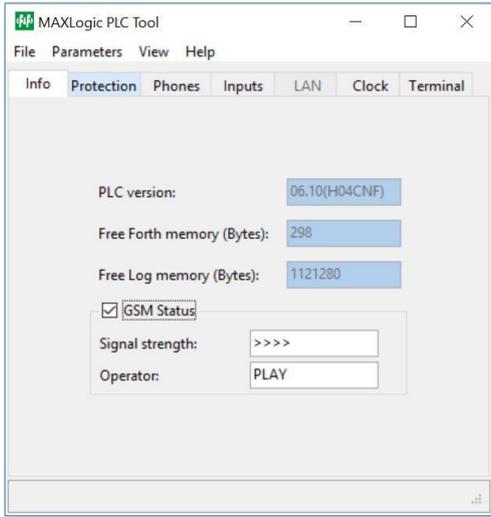
List of Tcl/Tk applications (launching additional menu windows)

Help:

Log - Console window for internal program logging and data exchange with the controller

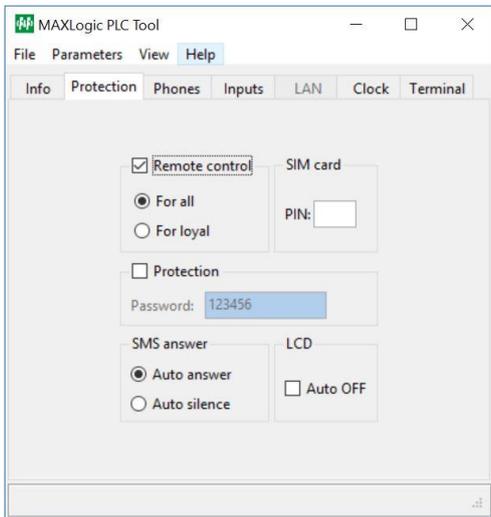
Help - Program version information

SYSTEM CONFIGURATION



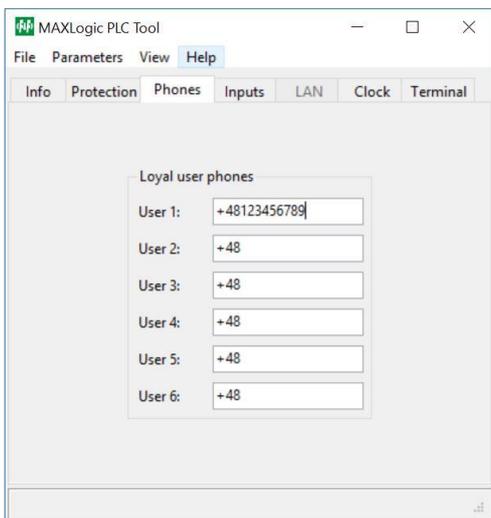
Info tab

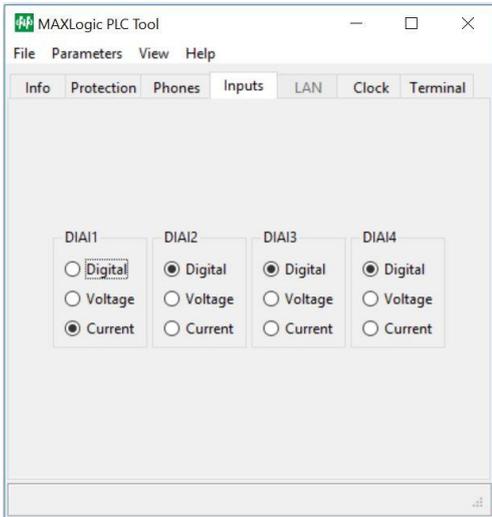
PLC version - firmware version
 Free Forth memory - free memory for ForthLogic applications
 Free Log memory - free internal memory for data logging
 GSM Status:
 Signal strength - GSM signal strength
 Operator - the name of the GSM operator of the SIM card used



Protection tab

1. Remote control:
 checked - enabled remote control by SMS;
 unchecked - SMS remote control is disabled
 For all - remote control for all users
 For loyal - remote control only for users 1-6
2. SIM card PIN: PIN code of actual SIM card (if activated)
3. Protection:
 checked - access to the system (via hyperterminal, MAXConfig and SMS) is protected by password;
 unchecked - no access control
 Password - establish an access password (a string of digits up to 15 characters long). Default password: 123456.
4. SMS answer:
 Auto answer - automatic answer for all incoming SMS.
 Auto silence - no automatic answer for incoming SMS.
5. LCD Auto off: Auto off the screen when keyboard is idle for 5 min.





Inputs tab

Software Configuration of DI/AI1 - DI/AI4:

Digital - digital input

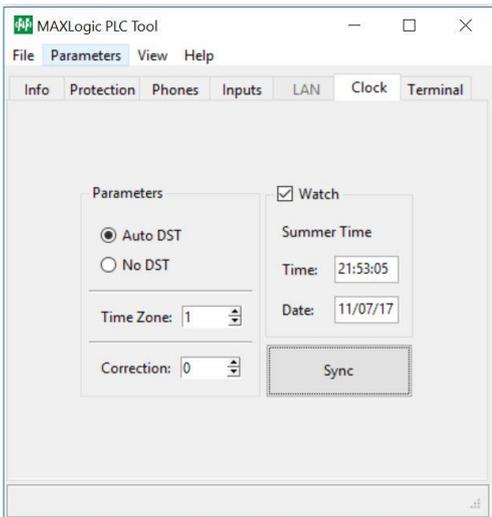
Voltage - analog input voltage [0 ÷ 10V]

Current - analog current input [4 ÷ 20mA]

WARNING!

It is necessary also to do hardware input configuration (see **HARDWARE CONFIGURATION**).

LAN tab - inactive



Clock tab

Parameters:

1. Automatic summer/winter time change function.

Auto DST - function enabled;

No DST - function disabled.

2. Time Zone. An integer ranging from -12 to +12, which refers to the time zone of the country or region where the controller is running. For Poland this is a +1 value.

3. Correction. An integer from -360 ÷ 360, corresponding to the desired system time correction in seconds. Correction should take place when we detect the deviation of the system time from the actual local time. System time correction is performed on the first day of each month at 21:00:00 by adding the correction value to the system time.

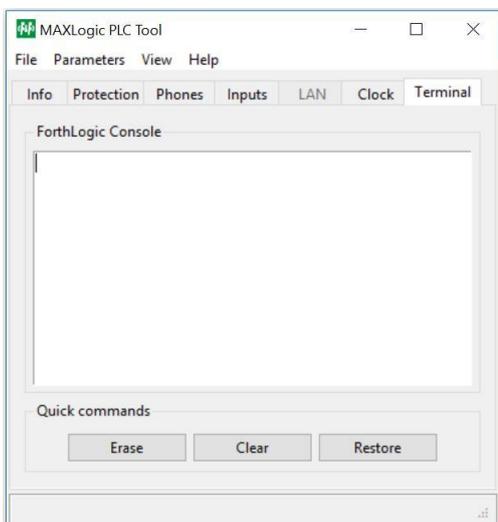
2. Watch:

checked - synchronized view of the controller time;

unchecked - no controller time view.

3. The Sync button synchronizes the controller with the PC system time.

To save the time parameters in the controller, use the Write command.



Terminal tab

ForthLogic Console - dialog box for terminal session with the controller

Quick commands - direct quick command buttons:

Erase - Erase all applications (downloaded programs)

Clear - Reset the outputs and system variables

Restore - Rebuild the system command dictionary (**BUILD DICTIONARY**). It also deletes downloaded applications and all defined commands.

H04Config - CONFIGURATION PROGRAM

MAX H04 is one of the few controllers that allow you to connect and use it without programming. The H04Config program can be used by anyone who does not want to learn languages and complicated procedures for programming controllers.

The notification task allows you to perform SMS or VOICE notification of one or more of the six users whose phones are stored in the appropriate sections of the configuration menu when there is a logical trigger on one of the inputs.

For digital inputs, the logical trigger is the closure of the circuit between this input and the ground GND (logical value 1). The minimum closing time (pulse) so that the signal is "visible" for the controller is 1 sec. For analogue inputs, the logical trigger is the threshold exceeded value. The notification is made as an SMS message.

The output control allows you to:

- remotely control the controller's digital outputs via commands sent as SMS text messages;
- implement a simple physical value regulator based on any of the analog inputs and digital outputs.

The physical value regulator mode is that when the measured value has exceeded the threshold, the controller switches the digital or relay output to active and vice versa.

WARNING!

Install the distribution folder on your computer at a location where the path will not contain spaces, such as local disk D or system disk C (D:\MAXfolder\H04config).

Run the H04config.exe file.

The program window opens. The program will automatically start downloading configuration data from the controller.

In the absence of software, a "No software" message will be reported. You need to upload the software to the controller.

Communication with the controller will be confirmed by the message "PLC connected to COMx" in the lower bar of the window.

In the absence of communication with the PLC, the message "PLC disconnected" or "PLC not found" appears on the lower bar.

MENU

File

Connect - Connect to the controller

Disconnect - Disconnect from the controller

Upload Software - Upload or retrieve H04Config software

Exit - close the program

Parameters

Read - Reads the current controller and application settings for all configuration tabs.

Save all - Save new controller and application settings for all configuration tabs.

Help

Log - Console window for internal program logging and data exchange with the controller

About - Program version

Language - language selection: PL, EN, RU.

TABS

System tab – system parameters

GSM field

GSM - sim card status text messages: logged in, not logged in, no sim.

Operator - the name of the GSM operator of the SIM card used

Signal - GSM signal strength 0-4

Info field

Firmware version - controller firmware version

Free memory - free memory for applications (bytes)

Software version - H04Config software version

Phones field

No. 1-6 - six phone numbers that are used for messaging. Enter the number in international format, eg: +48123456789.

Protection field

1. Remote control:

checked - enabled remote control by SMS;

unchecked - SMS remote control is disabled

For all - remote control for all users

For loyal - remote control only for users 1-6

2. SIM card PIN: PIN code of actual SIM card (if activated)

3. Protection:

checked - access to the system (via hyperterminal, MAXConfig and SMS) is protected by password;

unchecked - no access control

Password - establish an access password (a string of digits up to 15 characters long). Default password: 123456.

4. SMS answer:

Auto answer - automatic answer for all incoming SMS.

Auto silence - no automatic answer for incoming SMS.

5. LCD Auto off: Auto off the screen when keyboard is idle for 5 min.

Clock field

1. Automatic summer/winter time change function.

Auto DST - function enabled;

No DST - function disabled.

2. Time Zone. An integer ranging from -12 to +12, which refers to the time zone of the country or region where the controller is running. For Poland this is a +1 value.

3. Correction. An integer from $-360 \div 360$, corresponding to the desired system time correction in seconds. Correction should take place when we detect the deviation of the system time from the actual local time. System time correction is performed on the first day of each month at 21:00:00 by adding the correction value to the system time.

2. Watch:

checked - synchronized view of the controller time;

unchecked - no controller time view.

3. The Sync button synchronizes the controller with the PC system time. To save the time parameters in the controller, use the Write command.

DIAI settings tab

Configuration of analogue-digital inputs (1-4)

AI/DI1 ÷ AI/DI4 inputs must be hardware configured prior to installation and programming of the controller.

Type fields

Selection of the combined input type:

Digital - as digital

Voltage - as analog voltage 0-10V

Current - analogue current 4-20mA

Scale fields

A calculator that allows you to scale 4-20mA or 0-10V analog inputs to actual measured values.

Minimum - minimum value of the analogue measuring range, ie the value corresponding to 0V or 4mA.

Maximum - maximum value of the analogue measuring range, ie the value corresponding to 10V or 20mA.

Example. A 4-20mA analogue temperature sensor is connected to the controller. The measured temperature range is $-50 \div 100^\circ \text{C}$. The minimum is -50°C . The maximum is 100°C . Set the trigger threshold is 25°C and hysteresis is 5°C . If the temperature rises above 25°C , it will trigger, eg switch on the output. When the temperature falls below the hysteresis, ie below 20°C , the output will be switched off.

Correction - correction of the readings of the measured value on the analog input by +/-.

DIAI alarms tab

Alarm configuration for analog inputs AI1-AI4 and digital inputs DI1-DI4

Notification audio files:

To make voice notifications it is necessary to have a set of sound files located in the root of the SD card permanently inserted into the controller card reader.

You can create these files yourself using any human speech synthesizer or sound recording program (for example, using Microsoft® Windows Sound Recorder [START > Programs > Accessories]). Files must have a .wav extension with attributes: PCM format, MONO mode 7kBit/sec, 8000Hz 8bit sampling. If you can not create a file with such parameters, you can use Free Audio Converter (or similar) to convert the created file to the appropriate format and attributes. The program is located in the distribution file set in the folder "prog_help".

Files must have the following names:

di1warn.wav - digital or analog input alarm # 1
 di2warn.wav - digital or analog input alarm # 2
 di3warn.wav - digital or analog input alarm # 3
 di4warn.wav - digital or analog input alarm # 4
 di5warn.wav - digital input alarm # 5
 di6warn.wav - digital input alarm # 6
 di7warn.wav - digital input alarm # 7
 di8warn.wav - digital input alarm # 8
 powfwarn.wav - power failure
 powrwarn.wav - power back
 batlwarn.wav - low battery

DIAI1-DIAI4 fields

Alarm triggering option:

For DI (digital) inputs:

Enable high - high state / rising edge (input voltage on)

Enable low - low state / falling edge (input voltage off)

For AI (analog) inputs:

Enable high - upper threshold / max alarm. Set the scale value in the "DIAI Settings" tab.

Enable low - lower threshold / min alarm. Set the scale value in the "DIAI Settings" tab.

Select notification option:

SMS - SMS notifications for designated phone number.

VOICE - voice notification for designated phone number (play a .wav sound file in voice mode, the file must be on an SD card)

Message content (max 160 characters):

High SMS - for triggering option high (high input voltage / maximum alarm)

Low SMS - for triggering option low (low input voltage / minimum alarm)

Repeat - the number of minutes after which the notification will be repeated if the input status is continuously maintained. Parameter 0 (zero) does not cause repeated SMS messages.

Users field

Select a users for notifications.

DI alarms tab

Alarm configuration for digital inputs DI5-DI8

DI5-DI8 fields

Alarm triggering option:

Enable true - high state / rising edge (input voltage on)

Enable false - low state / falling edge (input voltage off)

Select notification option:

SMS - SMS notifications for designated phone number.

VOICE - voice notification for designated phone number (play a .wav sound file in voice mode, the file must be on an SD card)

Message content (max 160 characters):

True SMS - for triggering option true (high input voltage)

False SMS - for triggering option false (low input voltage)

Repeat - the number of minutes after which the notification will be repeated if the input level is continuously maintained. Parameter 0 (zero) does not cause repeated SMS messages.

Users field

Select a users for notifications.

Power alarms tab

Configuration of main and backup power alarms

POW field

Main Power Alarm Options:

Enable raise - notification of main power return

Enable fail - notification of main power failure (backup power required)

Select notification option:

SMS - SMS notifications for designated phone number.

VOICE - voice notification for designated phone number (play a .wav sound file in voice mode, the file must be on an SD card)

Message content (max 160 characters):

Raise SMS - for power raise

Fail SMS - for power fail

Repeat - the number of minutes after which the notification will be repeated if the power status is continuously maintained. Parameter 0 (zero) does not cause repeated SMS messages.

BAT field

Battery Alarm Options:

Enable B.Low - notification of battery low

Select notification option:

SMS - SMS notifications for designated phone number.

VOICE - voice notification for designated phone number (play a .wav sound file in voice mode, the file must be on an SD card)

Message content (max 160 characters):

B.Low SMS - for battery low

Repeat - the number of minutes after which the notification will be repeated if the power status is continuously maintained. Parameter 0 (zero) does not cause repeated SMS messages.

Users field

Select a users for notifications.

DO control tab

Configuration of digital outputs DO1-DO4



DOx fields

Control options:

1. Remote control - remote control (via SMS from user's phone) with a set of special commands.
2. Regulator - "two-state controller" - output control depending on the value of the selected analogue AI input:
 - a. Enable control - enable or disable regulator option (with inactive option the output is permanently off despite exceeding threshold values).
 - b. DOWN/Inverse and UP/Direct - selection of adjustment options:
 - DOWN/Inverse - lower threshold activation (COOLING type) - switching off the contact when the lower threshold is reached. Switching on after increase by hysteresis value.
 - UP/Direct - upper threshold activation (HEATING type) - switching off the contact when the upper threshold is reached. Switching on after decrease by hysteresis value.
 - c. Input - selection of AI input (1-4)
 - d. Threshold - threshold value.
 - e. Hysteresis - hysteresis value.

DOWN (COOLING)

TOP (HEATING)

3. Local control - output control option depending on the assigned input:
 - a. DI/AI - selection of control input type for this output: digital DI or analog AI.
 - b. Enable control - enable or disable the control option (with inactive option the output is permanently off despite the change of the DI input state or the reaching threshold value of the AI input).
 - c. DOWN/Inverse and UP/Direct - select action option:
 - For AI:
 - DOWN/Inverse - lower threshold activation - switching on when the lower threshold is reached. Switching off after increase by hysteresis value.
 - UP/Direct - upper threshold activation - switching on when the upper threshold is reached. Switching off after decrease by hysteresis value.

DOWN

UP

For DI:

- UP/Direct - mapping of the output signal to the assigned input (1-> 1, 0-> 0)
- DOWN/Inverse - reverse of the output signal to the assigned input (1-> 0, 0-> 1)

Direct

Inverse

- d. Level/Pulse - Output state option:
 - Level - permanent turn-on output state after activation of DI input or reaching threshold value of AI input (turn-off when analog input is decreased by hysteresis).
 - Pulse - timed turning on of the output state for a specified time in seconds after activation of the DI input or reaching threshold value of AI input
- e. Input - selection of input DI (1-8) or AI (1-4).
- f. Threshold - threshold value.
- h. Hysteresis - hysteresis value.

Q control tab

Configuration of triac outputs Q 1-3



Control options analogous to the "DO Control" tab.

GUI control tab

Configuration of LCD texts and menu items

Display x fields

Each next LCD text items correspond to the each next lines of text on the LCD (top to bottom). Switch between two available screens using $\langle \rangle$ buttons. For analog inputs, a scaled value of this input is automatically inserted into the line of text.

Mode - analog or digital input type mode, for which we configure text lines: DI - digital input; AI - analog input. x precision of the numbers (none - integer; x.x - precision of 1 (1 digit after the decimal point); x.xx - precision of 2 (2 digits after the decimal point))

Input - selection of input DI (1-8) or AI (1-4).

Name/True text - line of text. For AI - text before the value. For DI - text designated for input value 1 (ON).

Unit/False text - line of text. For AI - text after the value. For DI - text designated for input value 0 (OFF).



Menu field

Configures user menu items for setting such parameters as threshold, hysteresis, alarms levels and phone numbers. Entering the menu using the **Menu** button. Exit the menu with **Esc** button.

Parameter - parameter selection:

- DO ... control threshold - threshold for digital output DO1-DO4.
- DO ... controlhisteresys - hysteresis of digital output DO1-DO4
- RO ... regulator threshold - trigger threshold for digital output Q1-Q3.
- RO ... regulator histeresys - trigger hysteresis for digital output Q1-Q3.
- DIAI ... warning high threshold - max alarm threshold.
- DIAI ... warning low threshold - min alarm threshold.
- User ... phone - phone number of the loyal user.

Menu title text - line of text on the main menu bar.

Menu text - line of text for menu item.

DATA ENTERING

When entering a parameter value, move the cursor by $\langle \rangle$ (move to the next character position). The **F1** key gives you the option to select a set of symbols from the sets: [S] punctuation, math, and other characters, [D] digits, [P] uppercase Latin, [p] lowercase Latin. The selection of the active symbol set is indicated in the upper left corner of the input window (on a blue background). Use the keys

<time> MIN PULSE <nr> DOUT <nr> - output number 1 ÷ 4; <time> - time in minutes 1 ÷ 357913

Example:

ON 1 DOUT - switch on the DO1 output

10 MIN PULSE 2 DOUT - time switch for 10 minutes DO2 output

Feedback messages:

SUCCE! - correct execution of the command

BAD INDEX - output number out of range

REMOTE CONTROL DISABLED! - inactive remote control option

Control of outputs QO

ON|OFF <nr> QOUT <nr> - output number 1 ÷ 3; ON - on; OFF - off

<time> SEC PULSE <nr> QOUT <nr> - output number 1 ÷ 3; <time> - time in seconds 1 ÷ 21474836

<time> MIN PULSE <nr> QOUT <nr> - output number 1 ÷ 3; <time> - time in minutes 1 ÷ 357913

Example:

OFF 2 QOUT - switch off the Q2 output

30 SEC PULSE 2 QOUT - time switch for 30 seconds Q2 output

Feedback messages:

SUCCE! - correct execution of the command

BAD INDEX - output number out of range

REMOTE CONTROL DISABLED! - inactive remote control option

Inquiry for DI / AI inputs:

<nr> DIN? - the status of digital input DI; <nr> - input number DI 1 ÷ 8

<nr> AIN? - the status of analog input AI; <nr> - input number AI 1 ÷ 4

Example:

1 AIN? - the value of analog input AI1

Feedback messages:

AI = [value] - scaled value from the connected sensor, eg: "AI = 25.5"

1 INPUT IS CLOSED - 1 input state is on.

1 INPUT IS OPENED - 1 input state is off.

SUCCE! - correct execution of the command

BAD INDEX - output number out of range

REMOTE CONTROL DISABLED! - inactive remote control option

Output control parameters DO (regulation):

<float> <nr> DO THR|HYS WRITE - setting of threshold and hysteresis value

<nr> DO THR|HYS READ - threshold and hysteresis inquiry

ON|OFF <nr> DO CTRL - option of regulation function: ON - active; OFF - not active

THR - threshold; HYS - hysteresis

<nr> - output number 1 ÷ 4;

<float> - floating point value, eg 22.0 *WARNING! Use dot [.] , not a comma [,].*

Output control parameters Q (regulation):

<float> <nr> Q THR|HYS WRITE - setting of threshold and hysteresis value

<nr> Q THR|HYS READ - threshold and hysteresis inquiry

ON|OFF <nr> Q CTRL - option of regulation function: ON - active; OFF - not active

THR - threshold; HYS - hysteresis

<nr> - output number 1 ÷ 4;

<float> - floating point value, eg 22.0 *WARNING! Use dot [.] , not a comma [,].*

DIAI input alarm parameters:

<float> <nr> AIH|AIL THR WRITE - setting of alarm threshold values

<nr> AIH|AIL THR READ - query on the threshold values of alarms

ON|OFF <index> HIGH|LOW ALRM

AIH - maximum threshold; AIL - minimum threshold

<nr> - input number 1 ÷ 4;

<float> - floating point value, eg 25.0 *WARNING! Use dot [.] , not a comma [,].*

Input alarm parameters DI:

ON|OFF <nr> TRUE|FALSE ALRM - set alarm triggering options

TRUE - signal 1 (input closed); FALSE - signal 0 (input opened)

<nr> - input number 5 ÷ 8;

Power alarm parameters:

ON|OFF POW RISE|FAIL ALRM
ON|OFF BAT FAIL ALRM

Command option with password:

If you set an access password, all remote control commands must be preceded by a password.

Example: Status of input 1: "123456 1 AIN?"

Automatic response options:

AUTONAK - automatic replies disabled

AUTOACK - automatic replies enabled

At the same time, the following words are used when sending commands:

NAK - block single answer in auto response enabled mode, eg NAK ON 1 QOUT

ACK - force response in auto response disabled mode, eg ACK 1 AIN?

The default setting is automatic replies disabled (AUTONAK). To send an option, send the appropriate SMS command to the controller. The option is stored in non-volatile memory and is valid after the controller is restarted.

STATUS OF ACCOUNT AND VALIDITY OF SIM CARD

To perform service tasks such as activation and deactivation of services, checking status and completing an account, etc., USSD (Unstructured Supplementary Service Data) is used.

Check status and expiry date of the balance:

[password] NAK LAST . " *111# " USSD DROP

We only give the password if password access was established. In reply will come the SMS with the answer of the operator in which will be the current information for balance and the expiry date (notification format depends on the operator).

Recharge the account:

[hasło] NAK LAST ." *111*12345678909876# " USSD DROP

We only give the password if password access was established. In reply will come the SMS with operator response confirming the recharge of the account. Notification format depends on the operator.

■ Examples of USSD command codes are given in red. In fact, they are set up individually by mobile network operators.

FILE OPERATIONS

WARNING!

All the files needed for the controller are located on the enclosed CD or the website www.plcmax.pl.

LOADING AND STARTING THE APPLICATION (ForthLogic script)

The software development principles for the controller are described in the ForthLogic programming manual.

1. MAXConfig - download the application using the service program (see chapter MAXTool)
2. SD card
 - The text file containing the program created in ForthLogic language (application) should be called "autorun.txt" (with the extension .txt!).
 - Format the card to the FAT32 file type.
 - Upload the autorun.txt file to the SD card.
 - Insert the card into the controller cardreader. The file will be automatically loaded. When loading to the memory of forth-system file will be continuously checked. If forth-system encounters any program error it will pause application loading.
 - When the application is successfully loaded, the controller will emit beep sound. Then the file is automatically deleted from the SD card and application will automatically start.
3. NOTEPAD++ and PUTTY - the application can be loaded in the terminal dialog using the NOTEPAD++ and PUTTY programming environment, which includes a text editor, hyperterminal and ForthLogic programming tool. The application created in this editor can be directly sent to the controller. For a description of how this works, see the manual "Notepad++ / PuTTY interactive programming in ForthLogic language".

FIRMWARE RECOVERING

Firmware recovering is done through MAXTool

Recovering the firmware is performed in the following situations:

- when a new firmware version appeared;

- when you need to switch from the standard controller firmware to one specifically designed for solving individual user tasks (on a case-by-case basis);
- when password is lost;
- when an unforeseen failure of the controller system occurs.

PROGRAM RESOURCES

Parameter type	Resource
Internal memory for application [ForthLogic]	30kB
Internal memory for logging [DataLogger]	2,0MB
Integer constants [CONSTANT]	*
Mathematical Constants [FCONSTANT]	*
Integer variables [VAR]	128
Mathematical variables [FVAR]	64
Bit variables [FLAG]	128
String variables [STRING]	8

* limited by internal memory for application

ERROR MESSAGES

When interpreting the file "forthdic.txt", in case of an error, the display will show an error code message, not the text itself. In the terminal and remote mode of the fort-system, all errors that occur during the dialogue with the system are displayed in parentheses as text in English by default.

Code	Error message	Explanation
1	UNKNOWN WORD	Unknown forthlogic word
2	ILLEGAL USAGE	Applying a word in the wrong context (running or compiling)
3	ILLEGAL PARAMETER	Invalid word parameter (out of allowed limits)
4	INSUFFICIENT PARAMETERS	Insufficient number of parameters
5	DATA STACK EMPTY	The data stack is empty
6	DATA STACK FULL	Stack Overflow
7	RETURN STACK EMPTY	The return stack is empty
8	RETURN STACK FULL	Overflow of the return stack
9	OUT OF MEMORY	Insufficient memory in dictionary
10	MATHEMATIC STACK EMPTY	The mathematical stack is empty
11	MATHEMATIC STACK FULL	Mathematical Stack Overflow
12	SD CARD NOT FOUND	There is no SD / MMC memory card
13	FILE NOT FOUND	File not found
14	INPUT BUFFER OVERFLOW	Input buffer overflow
15	FILE SYSTEM BUSY	The file system is busy (for example, an audio file is played)
16	FILE EMPTY	The file is empty
17	WRONG CONSTRUCTION	Incomplete execution control structure (IF-ELSE-THEN)
18	FILE TRANSFER ERROR	Error while receiving file using Xmodem protocol
19	FILE TRANSFER TIMEOUT	Initially receiving the file using the Xmodem protocol did not start within 30 seconds.
20	COMPILE MODE NOT ALLOWED	Prohibition of compilation mode (applies to SMS texts)

TECHNICAL DATA

Inputs:	maximal resistance of external circuit on DIA1÷DIA4 inputs in digital input mode, input considered closed	500Ω
	input resistance of analog-digital input [DIA1÷DIA4]	
	- in voltage mode "0 ÷ 10V"	130kΩ
	- in current mode "4 ÷ 20mA"	120Ω
	maximum allowed voltage on analog-digital input [DIA1÷DIA4]	
	- in digital input mode	30V
	- in voltage mode "0 ÷ 10V"	30V
	- in current mode "4 ÷ 20mA"	30V
	ADC resolution when measuring analog parameters	10 bits
	maximum resistance of external circuit on DI5÷DI8 inputs, input considered closed	300 Ω
	maximum allowed voltage on digital input [DI5÷DI8]	6V
	max. pulse counting frequency at digital input / pulse length	16Hz / 30ms
Outputs:	maximum permissible voltage for open collector DO type output	50V
	maximum permissible current for open collector DO type output	
	- continuous	100mA
	- impulse (fill factor 20%)	400mA
	maximum permissible voltage for Q type output	
	- alternating current (resistive load)	600V AC
	maximum permissible current for Q type output	
	- alternating current (resistive load)	3A
	electrical endurance	indefinite
Microphone:	type of microphone	electret
	operating voltage	1,5V
	resistance of the microphone	2,2Ω
Audio output:	signal amplitude	250mV p-p
RS485:	communication protocol	MODBUS RTU
	exchange rate	9600bit/s
	maximum permissible line voltage	12V
	maximum working capacity of the line	250pF
GSM:	work frequency (according to GSM Phase 2/2 +)	
	- for EGSM 900:	
	- to receive	925÷960MHz
	- to send	880÷915 MHz
	- for DCS 1800:	
	- to receive	1805÷1880 MHz
	- to send	1710÷1785 MHz
	maximum radiation power [dBm]	
	- for EGSM 900 (according to Class 4)	33 (2W)
	- for DCS 1800 (according to Class 1)	30 (1W)
	receiver sensitivity [dBm]	
	- for EGSM 900	<106
	- for DCS 1800	<106
	antenna connector	SMA socket
	antenna gain [dBi]	2,15
	maximum speed in CSD mode	14400bit/s

SIM card:	standard used	GSM Phase 1, GSM Phase 2+
	power supply voltage	1,8V ; 3,3V
Memory card:	standard used	SD, SDHC, MMC
	supported file systems	FAT12, FAT16, FAT32
	supported capacity	less than 32GB
	power supply voltage	3,3V
Display:	technology	STN
	resolution	132 x 132
	number of colors	256
Keyboard:	number of buttons	9
	mechanical endurance	500000
Battery:	type	acidic gel
	maximum working voltage on the battery	13,8V
	maximum charging current	200mA
	current drawn from the battery	
	- voice, relays and display backlight turned on	275mA
	- waiting, relays and display backlight turned on	170mA
	- waiting, relays and display backlight off	55mA
Power:	voltage range without battery	9÷30V
	voltage range with connected battery	18÷30V
	maximum power consumption	3,5W
Environment:	working temperature	-10...+50°C
	storage temperature	-20...+60°C
	relative humidity (non-condensing)	90%
Mechanical:	maximum cross-section of connecting cables	1,5mm ²
	dimensions (without antenna) [w × h × l]	110x79x40mm
	weight	0,22kg
	mounting holes	98,2x38mm (M3,5÷M4,5)
	housing material	FRABS UL94 -V03

TRANSPORTATION AND STORAGE

The controller in the original package can be transported by private and specialized means of transport at temperatures between -20°C and +60°C. Do not expose the package to direct contact with liquids (rain, condensation, moisture, etc.) during transport and direct impact of loads exceeding 1 kg.

Store in the original package at -5°C to +60°C in a place not exposed to direct liquid (rain, condensation, etc.), molds, fungi, vapors, acids and other aggressive agents, with an average annual humidity value of up to 60% at +20°C, and an upper humidity value of up to 80% at +25°C.

WARRANTY

- The controller is subject to a 24-month warranty from the date of purchase.
- Warranty valid only with proof of purchase.

- Claims must be made at the point of purchase, from a service technician who performs assembly and programming services or directly at the manufacturer (tel. 42-2270971; e-mail: reklamacje@fif.com.pl)
- During the warranty period, the manufacturer undertakes to repair the controller or replace it with a new one within 14 days of delivery to the service center.
- The purchaser has the right to replace the controller with a new or a cash refund if an irrecoverable defect is found.
- The warranty does not cover:
 - mechanical and chemical damage
 - damage caused by improper or incompatible use of the instruction manual
 - damages resulting from the sale as a result of accidents or other events for which no liability is incurred by the manufacturer or the point of sale such as transport damage, etc.
- The warranty does not cover activities which, according to the instructions, should be performed by the user, eg: installation of a relay, electrical installation, installation of other units which are required by regulations, etc.