MX-4

USER MANUAL

VILTRUS ELECTRONICS

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1. Introduction

This Manual will show you how to configure the MX-4 data logger/controller by using the MX-4 configurator software.

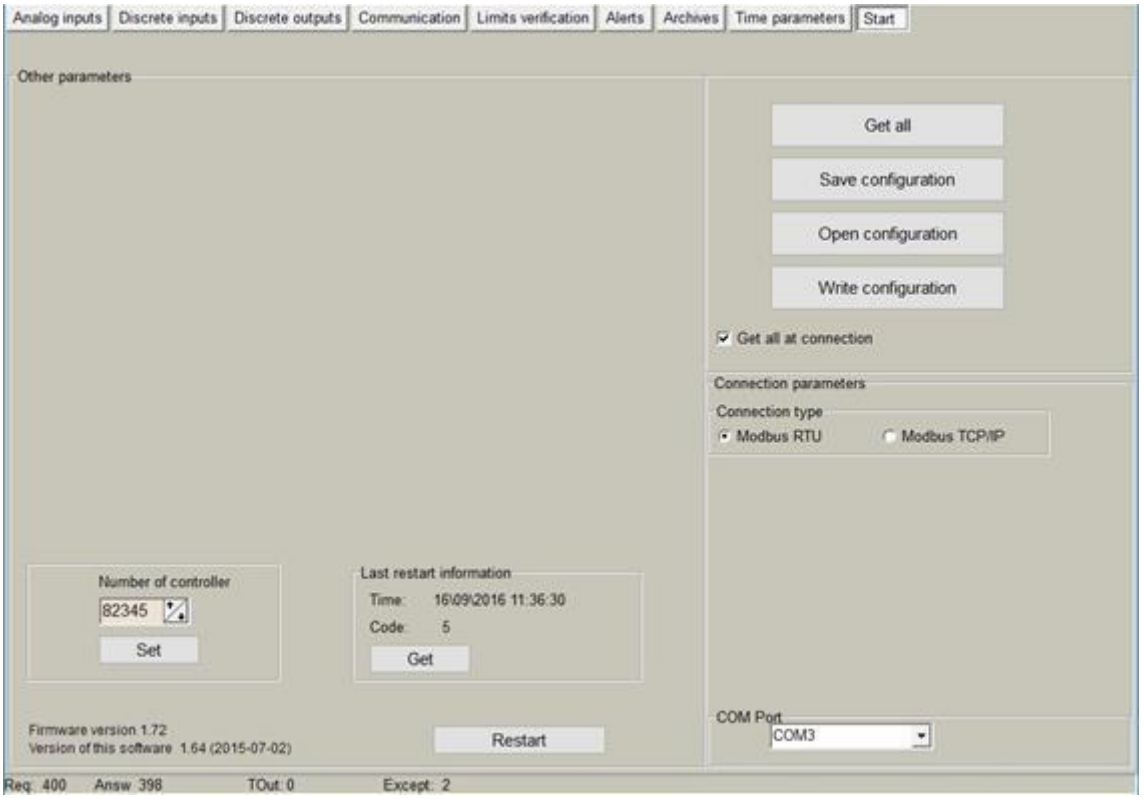


Figure 1. MX-4 Configurator

2. Setting up connection to the device

In order to configure the controller, user must connect its PC to the device by using any of the following interfaces:

1. USB port
2. Through a GPRS connection (only accessible after configuring GPRS APN, user and password inside the controller)

NOTE: Not all the models support above interfaces. Check your ordering code first.

2.1 USB connection

Steps to be followed:

- Connect an USB cable class B to the correspondent port
- Open MX-4 Configuration Tool
- Set up "**Connection Parameters**" frame Select "ModBus RTU" option under "Connection type"
- Configure “Bode” and “Parity” parameters; default values are:"19200", "none"
- Select COM port number assigned by your PC to the USB port
- Click on “**Get all**” to establish connection with controller.

2.2 GPRS Connection

Steps to be followed:

- Check GPRS antenna is properly connected to the device.
- Open MX-4 Configuration Tool
- Set up "**Connection Parameters**" frame o

- Select "ModBus TCP/IP" option under "Connection type"
- Add controller IP address and TCP port in "Host or IP" and “Port” text boxes, respectively
- Click on “**Connect**” to establish connection with controller.

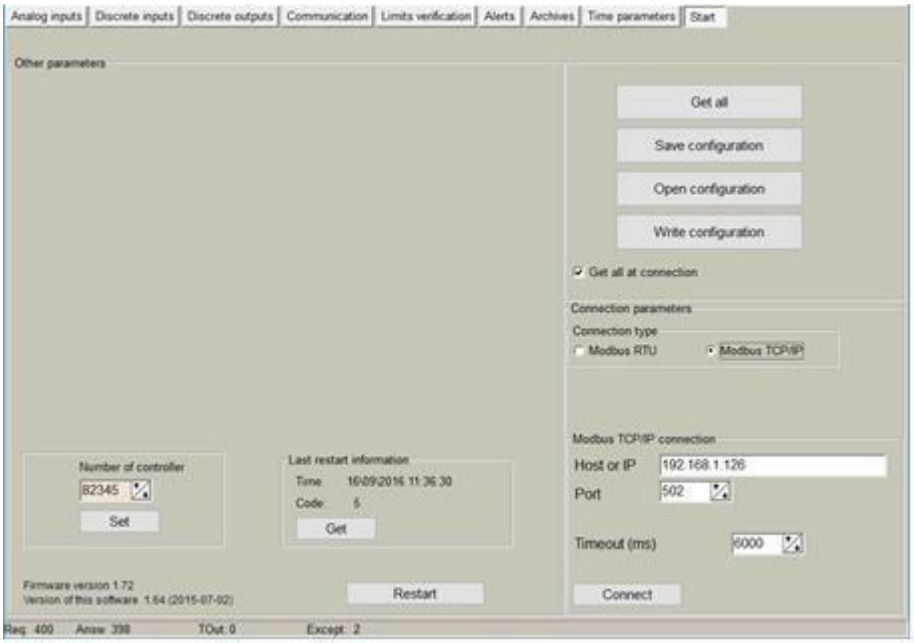


Figure 2. GPRS connection set up

3. “Start” tab

3.1 MX-4 Basic Information

Once user has established communication with MX-4, basic information such as *"Number of controller", "Last restart", "Firmware version", "Software version",*

etc. is shown in the left frame

3.2 Configuration files

This feature enables user to save and load configuration files so that programming a number of controllers with the same configuration becomes an easy process. Steps to be followed are:

1. Set up all the configuration parameters making use of MX-4 Configuration Tool.
2. Then, under "Start" tab, click on **"Save configuration"** button. A dialog will be shown requesting user to select folder destination.
3. Once the file has been stored, connect a new controller to the PC and then click on **"Open configuration"** and select the file previously stored.
4. Then, click on **"Write configuration"** button to load such configuration into the new controller.
5. A restart will be needed so that controller can start using the loaded configuration.
6. Repeat from step 3 with all the controllers that need the same configuration.

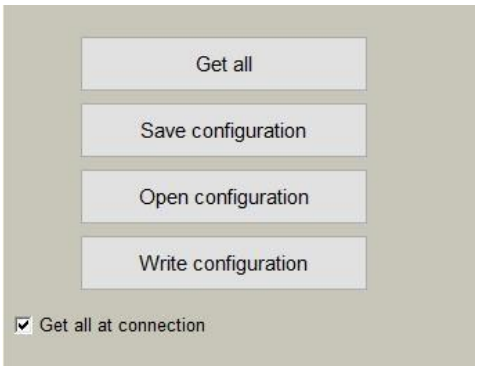


Figure 3. "Start" tab. Configuration files management

3.3 Status indicators

Several status indicators are shown in the MX-4 configuration tool in order to inform user about current performance of Modbus communication:

7. Req: number of Modbus requests performed.
8. Answ: Number of Modbus answers received.
9. Tout: number of Modbus requests not answered (time outs raised).
10. Except: number of Modbus errors.

Figure 4. "Start" tab. Status indicators

4. "Analog Inputs" tab

Go to *Analog inputs>Configuration*:

- Enable the analog input.
- Range: Select the sensor output range
- "MIN. value" / "MAX value" : Defines the sensor operation range
  "Low alarm limit" y "High alarm limit": In case of Alarms defined it configures the performance limits

- "Current value" is the current value read by the sensor and converted according the configured operation range.

Figure 5. Analog inputs configuration

Apart from checking the correct Analog inputs performance by using the "current values" column of the MX-4 Config. tool, it is possible to read directly the corresponding Modbus registers by using a Modbus function "3":

	Modbus Register list					
Description	**AI_1**	**AI_2**	**AI_3**	**AI_4**	**Data format**	**Type**
Analog input use (0- disabled, 1 – enabled)	4524	4525	4526	4527	Char	R/W
Measuring type (0-voltage, 1-current, 2-resistance)	4528	4529	4530	4531	Char	R/W
Min recalculated value Float[4]	4600-4601	4602-4603	4604-4605	4606-4607	Float	R/W
Max recalculated value Float[4]	4608-4609	4610-4611	4612-4613	4614-4615	Float	R/W
Physical value (Float[4])	4504-4505	4506-4507	4508-4509	4510-4511	Float	R
Recalculated value (Float[4])	4512-4513	4514-4515	4516-4517	4518-4519	Float	R

Figure 6. Analog inputs MX-4's Register list.

The "Physical Values" and "Recalculated Values" registers are real time registers. The values are updated each 1 second.

5. “Discrete inputs” tab

Discrete inputs can be configured within this tab. They are shown organized in columns and configuration parameters are shown in rows as follows:

- "Current State": Graphical representation of current status (open/closed).
- "Impulse quantity": Number of pulses counted from last reset.
- "Value": Calculated from multiplying number of pulses counted (Impulse quantity) and user-defined multiplier (Impulse multiplier).
- "Enabled": user enable/disable discrete inputs to be used. In order to save memory, it is recommended to only enable inputs in use.
- "Mode":
    - "Discrete Input": input works as a standard discrete input detecting its current state (1 / 0)
    - "Impulse counter": input is used as a standard pulse counter, storing the amount of pulses raised.
    - “Alarm signal”: input is used as an alarm input.
- "Alarm state": If "Alarm signal" option is selected, controller will raised an alarm when one of the following state is reached: "Open", "Close", "Both cases".
- "Enable archiving": If enabled, events produced by discrete inputs are stored in the data logging archive.
- "Debounce time": only pulses received within one or more “Debounce time” intervals are registered.
- "Impulse multiplier": user-defined multiplier. Values can be set from 1 to 1000.
- "Set initial amount of pulses": initial value for pulse counter can be set here.

NOTE: After configuration is completed, click on "**Set**" button in order to save changes.

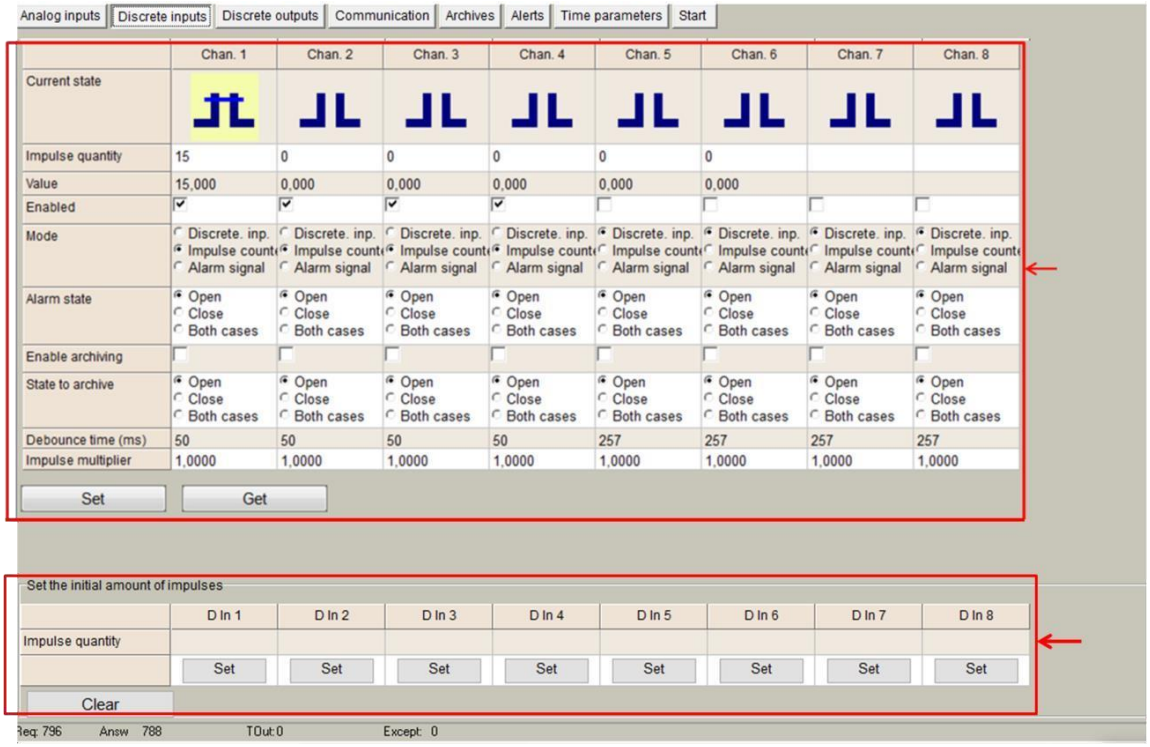


Figure 7. “Discrete inputs” tab

Discrete input parameters and values can be read and set using the following internal Modbus registers:

4202-4217	Discrete input use (0 - Disabled, 1 – Enabled)	Char	R/W
4218-4233	Discrete Input working mode (0- discrete input, 1 - impulse counter, 2- alarm signal, 3- time accounting)	Char	R/W
4234-4249	Discrete input archive type (0 – Open, 1 – Close, 2-Both cases)	Char	R/W
4250-4265	Discrete input alarm state (0 – Open, 1 – Close, 2 – Both cases)	Char	R/W
4266-4281	Discrete input archive (0 – store, 1 – not to store)	Char	R/W
4282-4297	Discrete input debounce time ms (0 -1000 ms)	Int (16 bit)	R/W
4330-4345	Discrete input state (0 – Open, 1-Close)	Char	R
4346-4377	Impulse count	Int(32 bit)	R

6. “Discrete Outputs” tab

The MX-4 has eight discrete outputs that can perform in 2 different working modes:

- Manual controls. It is possible to enable/disable the relay status by using the Manual controls that appear in *Discrete outputs>Configuration* .
- Manual test. It is possible to test manually each DO by sending a configurable pulse. It is possible to configure the '*Time of impulse (milliseconds)*' in the *'programmed controls panel'*

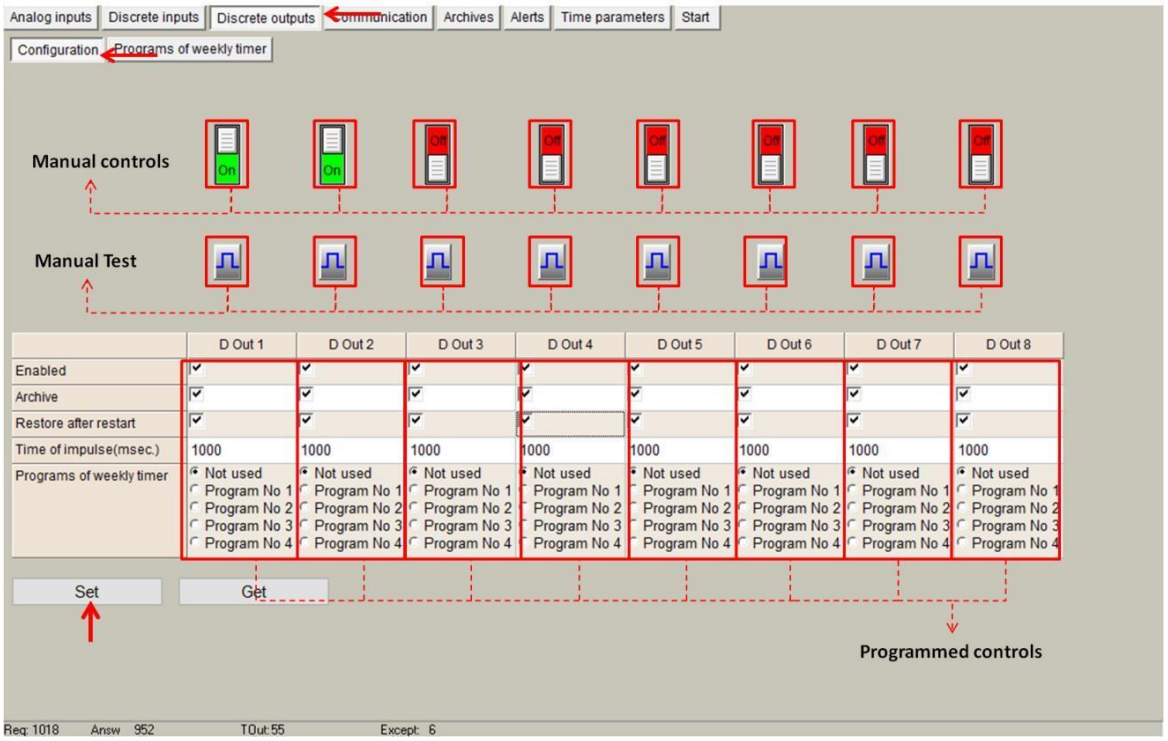


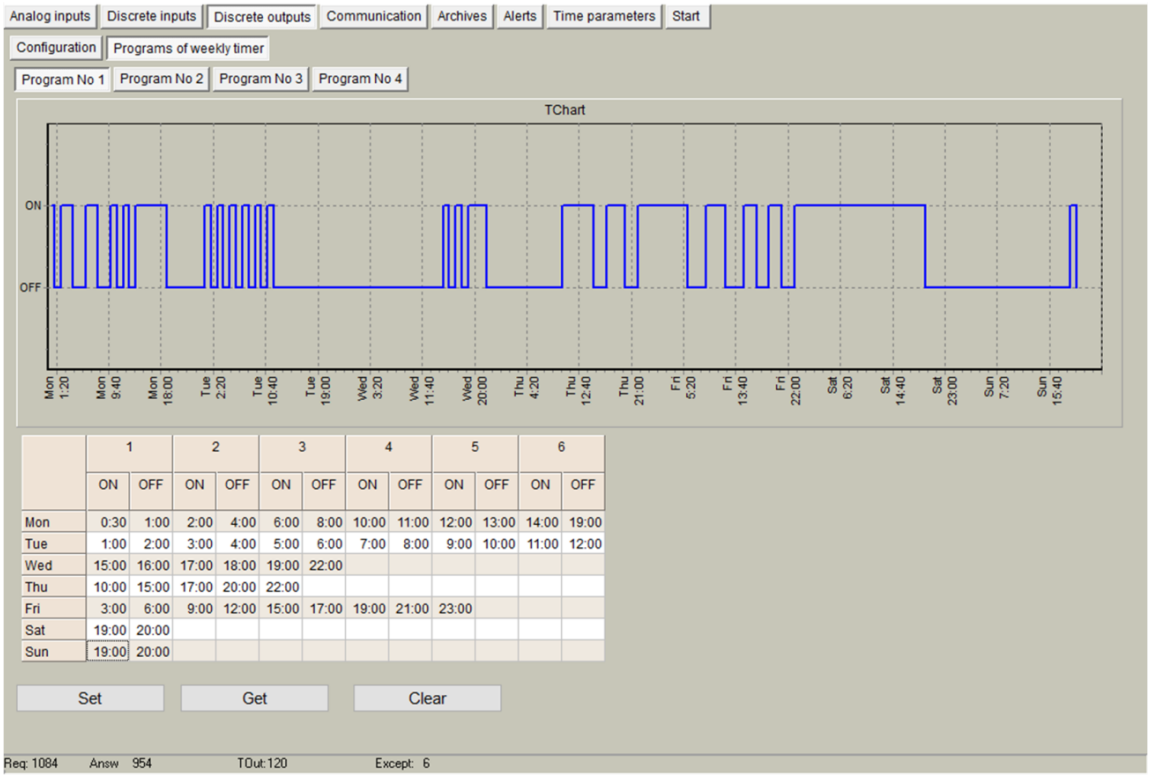
Figure 8. “Discrete outputs” programmer

- Also it is possible to manage the state of the relays by using the MX-4 register list with Modbus function '3' for reading or '16 for writing Discrete Output use (registers 4100 4107) and Discrete Output current state (4150-4157) as shown in the following example:

	Modbus Register list - Values										
Description	DO_1	DO_2	DO_3	DO_4	DO_5	DO_6	DO_7	DO_8	Data format	Type	
Discrete Output Use (0-disabled, 1 – enabled)	1	1	1	1	1	1	1	1	Char	R/W	(ALL ENABLED)
Discrete OutputCurrent State (0-OFF, 1 – ON)	1	0	0	0	0	0	0	0	Char	R/W	(DO1=ON, REST=OFF)

Figure19. Discrete Outputs MX-4's Register list

- Programmed: In case of the 'program mode', it is possible to program 4 different working calendars related to the discrete outputs. For this purpose, go to ' *Discrete outputs> programs of weekly timer'* and load them to the different discrete outputs:



	1		2		3		4		5		6	
	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF	ON	OFF
Mon	0:30	1:00	2:00	4:00	6:00	8:00	10:00	11:00	12:00	13:00	14:00	19:00
Tue	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00
Wed	15:00	16:00	17:00	18:00	19:00	22:00						
Thu	10:00	15:00	17:00	20:00	22:00							
Fri	3:00	6:00	9:00	12:00	15:00	17:00	19:00	21:00	23:00			
Sat	19:00	20:00										
Sun	19:00	20:00										

Figure 20. "Discrete outputs" Program No1

7. "Communication" tab

7.1 Communication > GPRS

As previously described, MX-4 can be configured through a GPRS link. In order to do so, user must enable GPRS connection as shown below. Then, click on "**Set**" button in order to save changes.

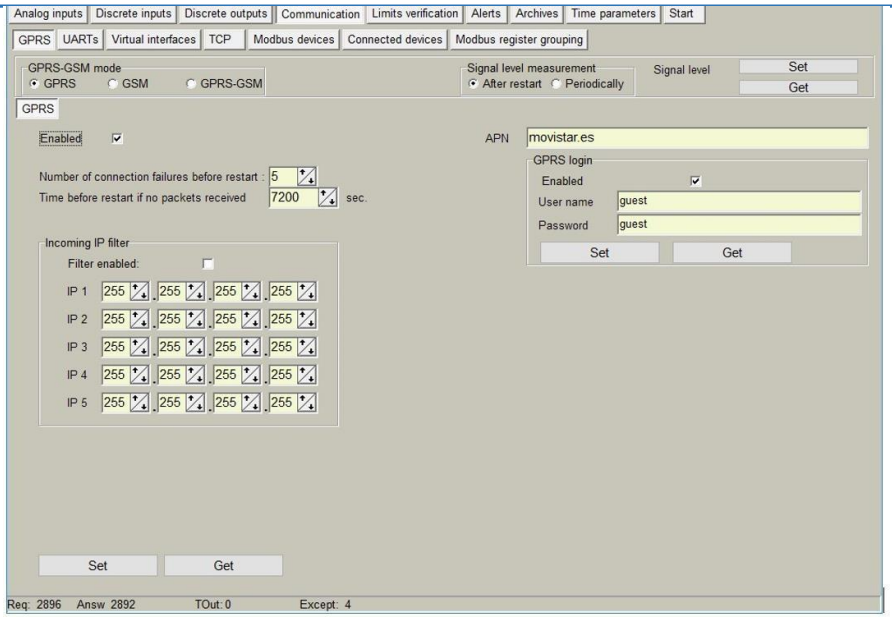


Figure 9. "GPRS" Tab. Enabling communication

Within this tab, different services can be configured or checked.

1. GPRS connection parameters:
   - "APN": access point name provided by Internet Service Provider (ISP).

If needed by ISP, credentials can also be configured here:

- "Username": provided by ISP.
- "Password": provided by ISP.

NOTE: After configuration is completed, click on "**Set**" button in order to save changes.

2. Connection status. Once GPRS connection is established, status will be shown.

7.2 Communication > UARTs

Each UART can be configured individually. It is recommended to check peripheral devices UART constraints before setting up parameters in the controller configuration tool.

NOTE: All devices connected to the same MX-4 UART must have the same communication parameters.

- "Bode": Transmission rate (bauds per second).
- "Parity": Communication Parity.
- "Data bits": Number of data bits within the communication packet.
- "Stop bits": Number of stop bits within the communication packet.
- "Packetization":
  - "time": One packet time has been reached, it is considered that the packet has been properly sent.
  - "Symbol". Every time a "packet symbol" is received, it is considered that the packet has been properly sent.
  - "Length". Once the "packet byte count" has been reached, it is considered that the packet has been properly sent.
- "Packet time": Transmission duration.
- "Packet symbol": Symbol which defines packet ending.

- "Packet byte count": Length which defines packet size
- "Mode": Full duplex or half duplex
- "Destination of DTR": bit which defines the "Data ready" state has been reached. It must be configured following peripheral devices connected to MX-4 UARTs vendor information. By default, if this information is not available, it is recommended to select "OFF when send" option.

NOTE: After configuration is completed, click on "**Set**" button in order to save changes.

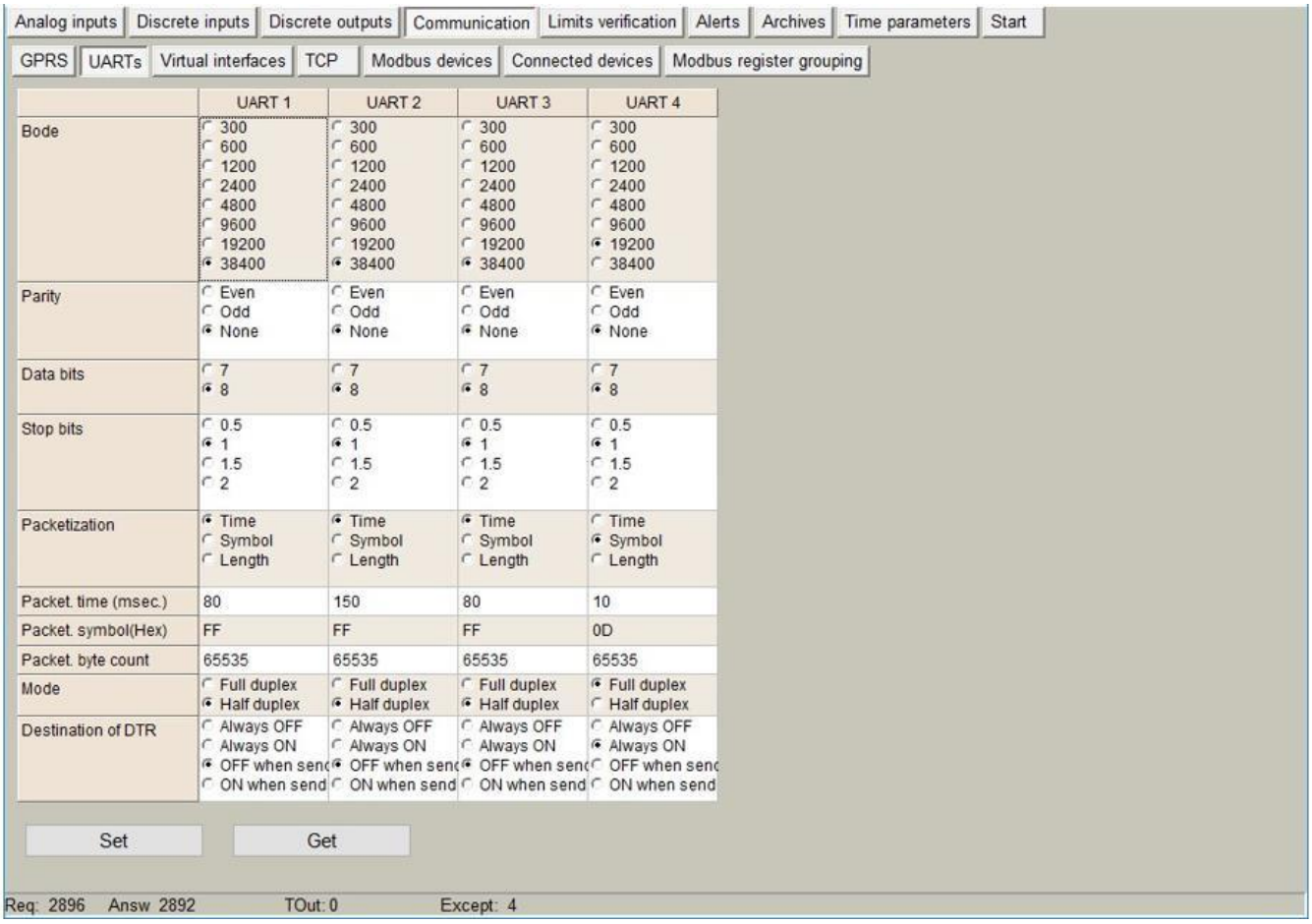


Figure 10. "UARTs" tab

7.3 Communication > Virtual interfaces

The MX-4 can perform as communication gateway, Modbus server/client and data logger simultaneously. In order to set up these options, different virtual interfaces are needed as shown below

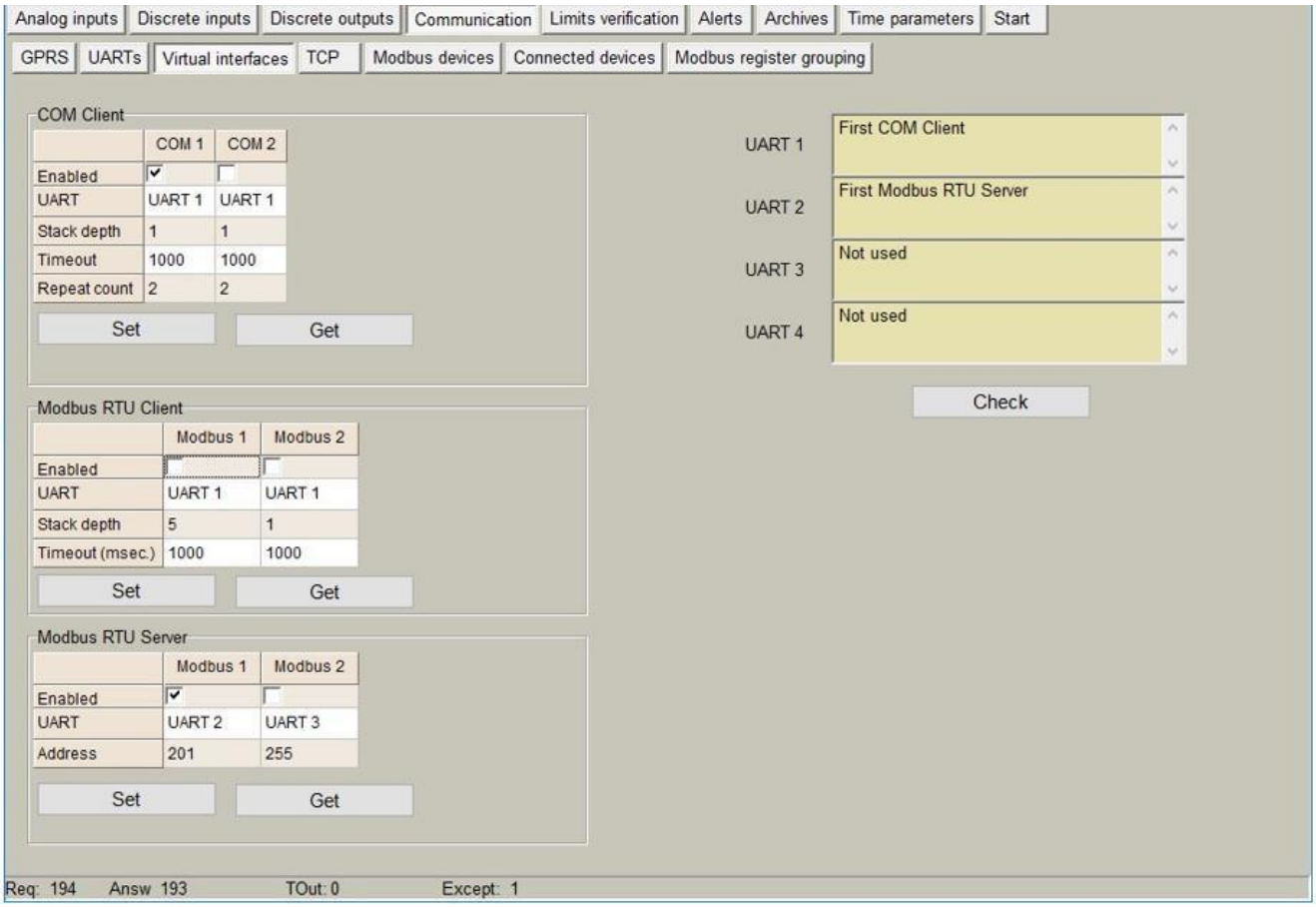


Figure 11. "Virtual interfaces" tab

- "COM Client". It is needed to configure a COM Client every time a "transparent" communication mode is needed. This is mandatory in order to read devices not compatible with Modbus RTU/TCP protocols.

Configuration parameters are:

- "Enable": Do not enable any COM client if not needed.
- "UART": Select the UART number in which a COM Client will be configured.

NOTE: Once a given UART is selected to be a COM client, it cannot be used with any other configuration such as Modbus client/server.

- "Stack depth": number of parallel executions that can be done in parallel by the COM client.
- "Timeout": it defines the amount of milliseconds defined as time out.
- "Repeat count": number of retries defined in case of transmission error.

NOTE: COM Client must always be used when peripheral devices connected to a given UART use protocols such as IEC-102, DLMS, etc. NOTE: After configuration is completed, click on "**Set**" button in order to save changes.

- "Modbus RTU Client". This mode working mode must be used when the MX-4 behaves as master in a Modbus RTU network (it sends Modbus requests to the slaves connected to the Modbus RTU network). These requests will be defined under the "Modbus devices" tab. Parameters to be configured are:
  - "Enable": Do not enable any Modbus RTU client if not needed.
  - "UART": Select the UART to be associated to the Modbus RTU client.

NOTE: Once a given UART is selected to be a Modbus RTU client, it cannot be used

with any other configuration such as COM client.

- "Stack depth": number of requests that can be stacked in the UART buffer. It is recommended to set this value to 1 by default.
- “Timeout”: it defines the amount of milliseconds defined as time out. NOTE: After configuration is completed, click on "**Set**" button in order to save changes.

- "Modbus RTU Server". This mode is used when the MX-4 will be used as Modbus slave in a network. Requests from a Modbus server will be received and answered.
  - "Enable": Do not enable any Modbus RTU server if not needed.
  - "UART": Select the UART to be associated to the Modbus RTU server.

NOTE: Once a given UART is selected to be a Modbus RTU server, it cannot be used with any other configuration such as COM client.

- "Address": Define Modbus address for MX-4. Modbus master must send requests to the given address.

NOTE: After configuration is completed, click on "**Set**" button in order to save changes.

7.4 Communication > Modbus devices

The MX-4 can read up to 100 Modbus RTU devices through UART 'x'.In order to configure Modbus RTU client list, follow the next steps:

- Go to *Communication>Virtual interfaces*
- Once the virtual interface has been enabled under Modbus RTU client- ‘UART x’, the list of requests for the Modbus client must be configured. For this purpose, go to *Communication>Modbus devices>Configuring modbus devices> Modbus RTU client*

It must be configured as much lines as Modbus RTU requests required. The number of requests can be configured in "Amount of requests", where:

- "Address": Slave device Modbus Address.
- "Function": Modbus RTU function.
- "Registers/coils ":Register/s address to be requested.
- "Amount of registers/coils": number of registers to be read from the register address configured in “Register/coils”
- MX- Reg. index: Internal MX-4’s RAM memory index where data is recorded. In case of MX-4 it starts in the address 52000 (index =0 => RAM Modbus address=52000@DEC).
- Priority: It configures the request management priority.

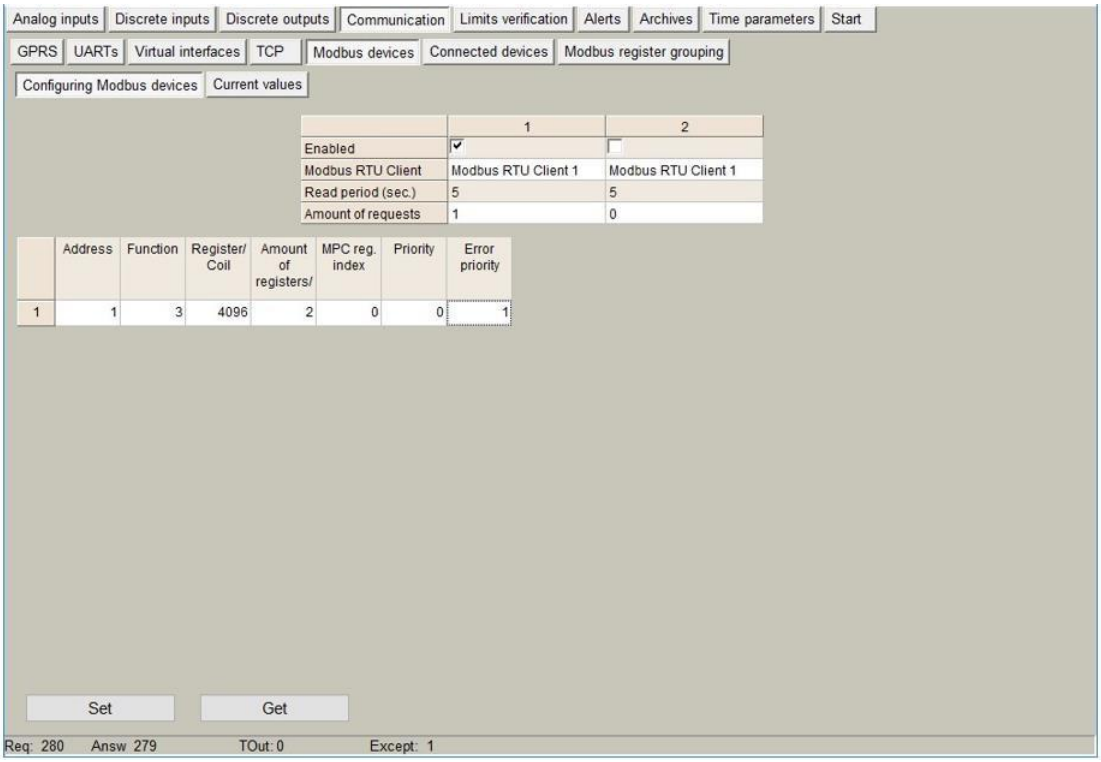


Figure 12. "Modbus devices" tab. Modbus RTU client parameters list configuration

NOTE: Maximum number of requests per each Modbus RTU Client is 50
NOTE: There exist 2 Modbus RTU clients. In case that both must work together 2 different UARTs must be used, one per each Modbus RTU client.

After the previous method has been configured, it is possible to check the received information through the Modbus RTU/TCP client in "Current values" tab, also enabling correct performance testing.

8. "Limits verification" tab

This tab enables users to set up limits verification raising events for issuing alerts when condition is met. To create the list, follow the next steps:

3. Choose "Count of limits" in order to start creating the number of positions desired;
4. Choose "Type of limit" (this must to be done first) among the following options:
   - Over H: event will be generated when the value is above the high limit.
   - Under L: event will be generated when the value is below the low limit.
   - Over H & Under L: event will be generated when the value is out of the range between high and low limit.
   - Under H & Over L: event will be generated when the value is within the range between high and low limit.
   - Equal L: event will be generated when the value is equal to the low limit.
5. Enter register number you want to control or choose from Main fields list (To create and/or edit list of limit's values use file limits .csv, that is in program's folder.);
6. Enter data type, corresponding to data type of used register;
7. Choose limits;
8. Delay time (in seconds), if you want to filter accidental ar short time events;
9. Finally, add a code of event (value must to be from 0 to 99 and will be

used for alerts SMS sending)

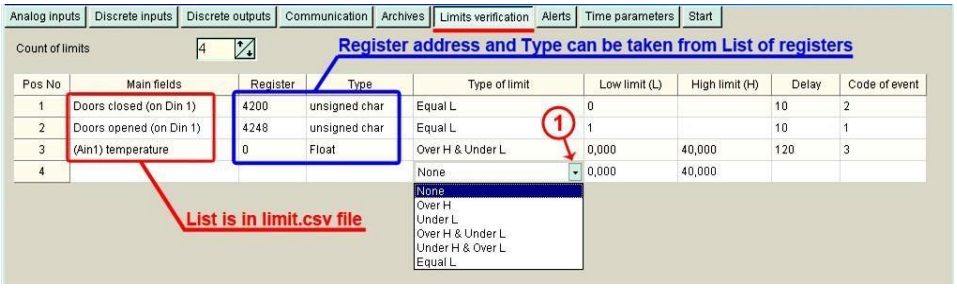


Figure 13. "Limits verification" tab

9. "Alerts" tab

MX-4 is able to send short SMS text messages based on discrete inputs status or events generated by limits verification feature. In order to set up the SMS alert component, follow the next steps:

10. Select "Enabled" checkbox.
11. Choose how many phone numbers will get SMS messages (max. 5 phone numbers).
12. Fill table with phone numbers.

NOTE: User can block SMS sending feature during controller testing procedures by selecting from discrete input list which one blocks SMS sending (if "none" is selected – SMS blocking is disabled). Closed discrete input disables SMS sending.

9.1 SMS Alerts on discrete inputs

All discrete inputs' state (ON and OFF) can be used for sending SMS alerts. For each discrete channel's state any text can be added (max. 160 symbols).

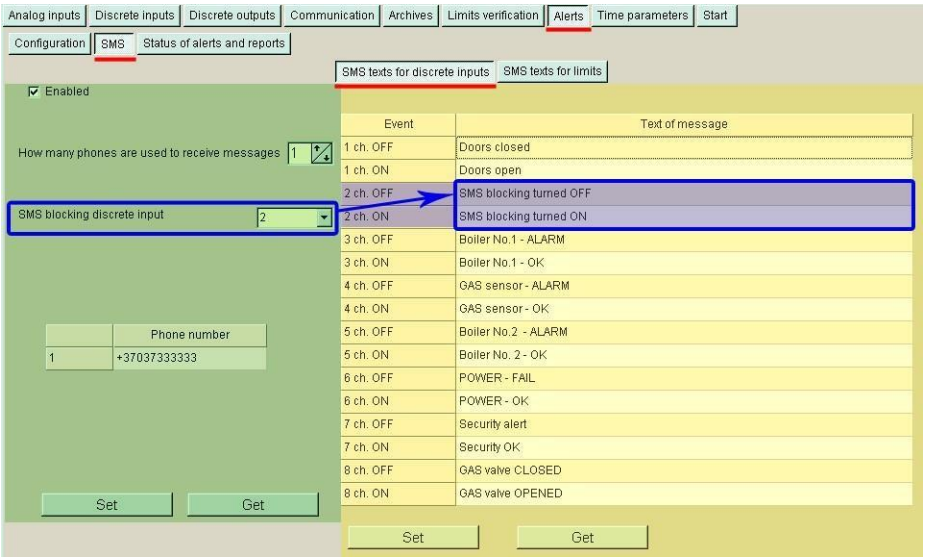


Figure 14. SMS alerts for discrete inputs configuration

9.2 SMS Alerts on Limit verification

SMS alerts for limits is used for sending SMS alerts when alert conditions is set in “Limit verification“ tab. Codes of events are used in this screen to configure alert messages as shown in the following figure.

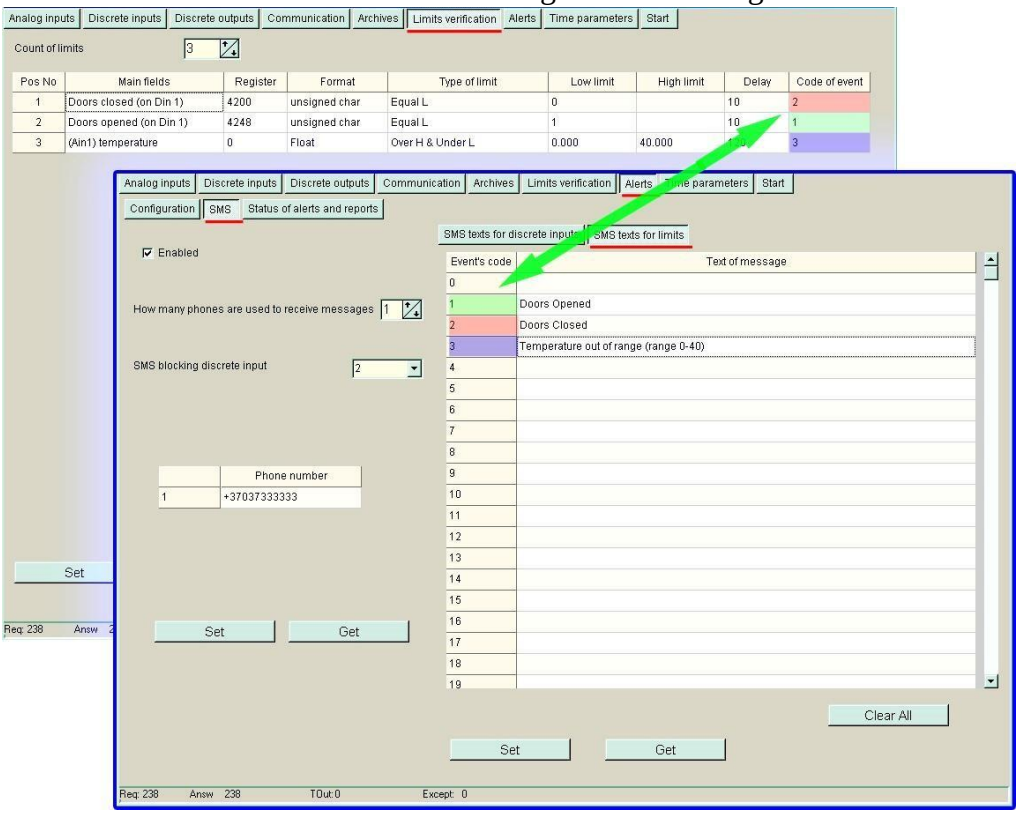


Figure 15. SMS alerts for limits configuration

10. "Archives" tab

The MX-4 has an internal 8MB flash memory. In case, the device is used as data logger, the following steps must be done:

- Go to *Archives> Configuration*
- In "Storage parameters" frame, configure the following:
  - *"Period":* It defines storage interval. Internal memory is organized in different blocks depending on the devices nature which are connected to the MX-4.

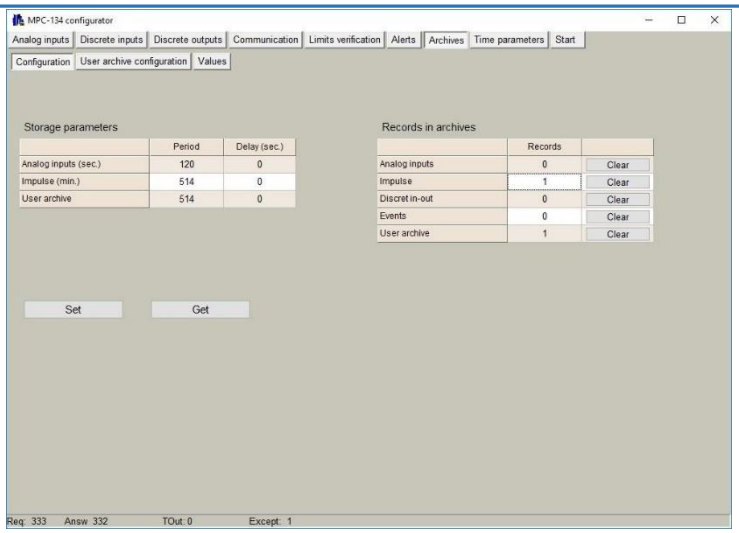


Figure 16. "Archives" tab. Storage frequency configuration

- In case user needs to customize storage blocks, signals acquisition must be configured accordingly. Memory block used will be defined as "User Archive" (see next step).
- Go to *Archives>User Archive Configuration*
- Under this tab, user can configure datalogging following his own requirements. In the next pages, a configuration example is given by setting the following parameters:
- *"Count of parameters"*: number of registers to be stored.
- *"Register"*: Specific register to be stored.

NOTE: Timestamp is registered automatically.

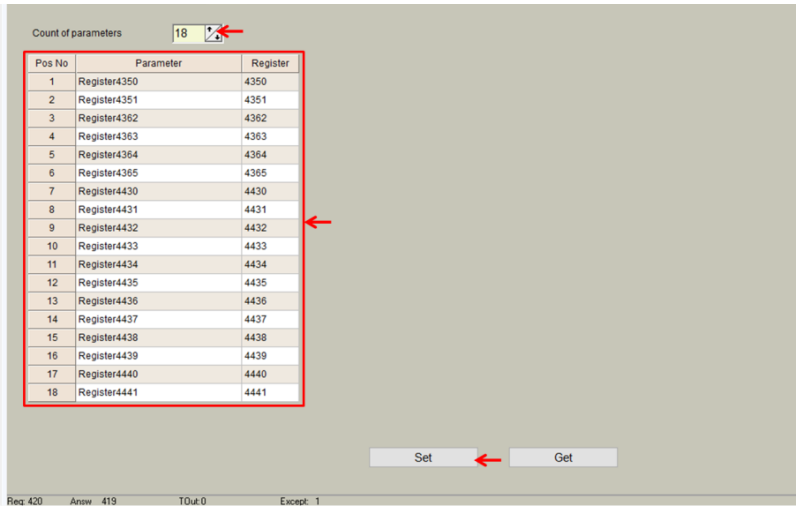


Figure 17. "Archives" tab. User archive configuration

In order to check current data logged in the internal memory, go to *Archives > Values > User archive* tab. This is only a test feature in order to ensure data logging is performing correctly.

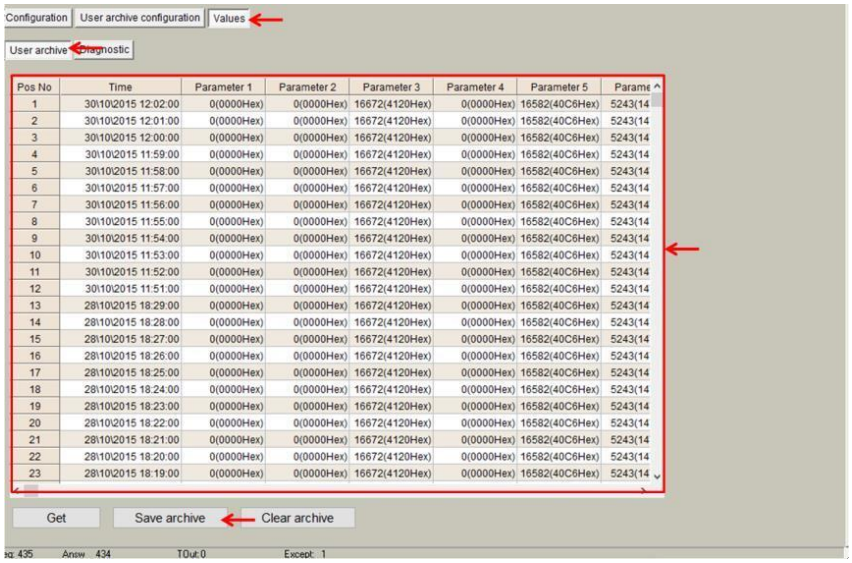


Figure 18. "Archives" tab. User archive current values

NOTE: Internal data logging memory is organized as a file system accessible through the use of standard Modbus function 20 "File register".

11. "Time parameters" tab

This tab enables users to set up time synchronization between MX-4 Real Time Clock (RTC) and external time references (PC time).

12. Abbreviations and explanations

- **Xn –** is a number of sockets. This information is provided for manufacturer's purpose and used in data schemas and connection diagrams.
- **GSM – Global Standart for Mobile Communications.** This interface is prepared for remote connections and data bidirectional data transfer over Global Standart Mobile network.
- **GPRS -** a packet oriented mobile data service on the 2G and 3G cellular communication system's global system for mobile communications (GSM).
- **IP** address - An **Internet Protocol** (**IP**) **address** is a numerical label that is assigned to devices participating in a network that uses the Internet Protocol for communication between its nodes.
- **TCP/IP** – Transmission Control Protocol is for communication between computers, used as a standard for transmitting data over networks and as the basis for standard Internet protocols.
- **MAC** address –**Media Access Control** address is a unique identifier assigned to most network adapters.
- **UART –** An **Universal Asynchronous Receiver/Transmitter** is a type of "asynchronous receiver/transmitter, a part of computer hardware that translates data between parallel and serial forms. UART are commonly used

in conjunction with communication standards such as EIA RS-232, RS-422 or RS-485. Record (UARTx) on top of enclosure also is used as serial interface number.

- **GND –** ground wire contact
- **RS232 -** the traditional name for a series of standards for serial binary single-ended data and control signals connecting between a DTE (Data Terminal Equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial ports. The standard defines the electrical characteristics and timing of signals, the meaning of signals, and the physical size and pin out of connectors. RS232 interfaces are prepared for connection of peripheral devices (example energy meters, controllers, machines and etc.)**.**
- **TD –** contact for transfer data wire of RS232 socket
- **RD –** contact for read data wire of RS232 socket
- **DTR –** contact for Data Transmit Ready wire of RS232 socket
- **RS485 -** standard defining the electrical characteristics of drivers and receivers for use in balanced digital multipoint systems. The standard is published by the ANSI Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA). Digital communications networks implementing the EIA-485 standard can be used effectively over long distances and in electrically noisy environments. Multiple receivers may be connected to such a network in a linear, multi-drop configuration. RS485 interfaces are prepared for connection of peripheral devices (example energy meters, controllers, machines and etc.).
- **A+ –** contact for positive wire of RS485 socket
- **B- –**contact for negative wire of RS485 socket
- **USB – Universal Serial Bus** is an industry standard, that defines the cables, connectors and protocols used for connection, communication and power supply between computer and electronic devices. USB type B socket is prepared for connection to PC (Personal Computer). USB type A socket is prepared for connection to peripheral devices (example memory stick's and etc.).
- **Socket** – is an endpoint of a bidirectional inter-process communication flow across an Internet Protocol-based computer network, such as the Internet**.**
- **Status –** device status indicating LED
- **Uoutput –** status of power for external device indicating LED
- **TX/RX –** data transfer/receive indicating LED
- **Central computer –** server or a computer, where data can be sent.

13. Safety instructions

To install and setup device, special technical knowledges are needed. Call to seller or certified professionals to connect and setup device!

Before connecting to power supply, be sure that:

13. Controller is not damaged (no cracks, melted, broken or exposed areas)
14. Controller is used with right and correct thickness cables.
15. Controller and antenna are installed indoor.
16. The controller is intended for supply from a Limited Power Source (LPS) with current rating of overcurrent protective device not greater than 2A
17. The highest transients on the DC secondary circuit of LPS, derived from AC main supply, shall be less than 71V peak.

18. The associated equipments (AE): PC and PSU (LPS) shall comply with the requirements of Standard EN 60950-1.
19. Controller is dry;
20. Ambient temperature and humidity is in normal range;
21. Other types of devices (counters, etc.) are connected correctly by using manufacturer‘s regulations.
22. The end of stranded conductor shall not be consolidated by soft soldering and must to be terminated
23. Device, PC and other pheripherical devices are strictly connected through one double pole breaker (current break less than 5A and space between breaker contacts more than 3mm.) Pole breaker has to be in building‘s wiring and in reachable place with markings

14. Technical Data

14.1 Communication interfaces

Interfaces	Technical data
RS485	up to 1.2 km, max 32 transceivers, speed up to 38,4 Kbits/s
RS232	up to 15m, speed up to 38,4 Kbits/s
GPRS	3 band 900/1800/1900 MHz
USB	Type B, version 2.0
Discrete INPUTS	“Dry contact”
Discrete OUTPUTS	Open contact, up to 50V , up ⎓ to 500mA
Analog INPUTS	Current 0/4-20mA, 0-5 mA ; Voltage 0-5V, 0-10V; Thermoresistor PT100 or PT1000; error ±0,15%

14.2 Protection

Insulation voltage between power supply and second circuits	1000 V
Insulated interfaces	B, C (see Configuration code)
Analog INPUTS	Yes
Discrete INPUTS	Yes

14.3 Indication

Indication type	LED’s
Indicated parameters	• Each discrete input status • Each discrete output status • UART Transfer/Receive • GSM/GPRS modem status, Transfer and Receive

14.4 Power supply

Power supply	9 ÷ 36 VDC ⎓
Power consumption	Up to 10 VA

14.5 Construction

Mounting	DIN35 rail
Dimensions	197x128x50 mm
Enclosure protection	IP20

14.6 Working conditions

Working temperature	From - 25 ^{o}C to + 60^{o}C
Storage temperature	From - 40 ^{o}C to + 60^{o}C
Relative humidity	From 5 % to 95 % non-condensing

14.7 Safety parameters

Safety requirements	EN 61010-1:2002
Electromagnetic compatibility	EN 55022:2000+A1+AC:2002+A2:2003 EN 55024:2000+A1:2003+A2:2003 EN 61000-4-2+A1+A2:2002 EN 61000-4-3+A1:2004 EN 61000-4-4:2005 EN 61000-4-5:2002+A1:2003 EN 61000-4-6:2002+A1:2003

14.8 Other parameters

Archive storage memory	8 MB
Configuration settings storage without power supply	More than 5 years
Real time clock	Yes
Firmware loading	Yes. Through RS232/USB and GSM/GPRS.