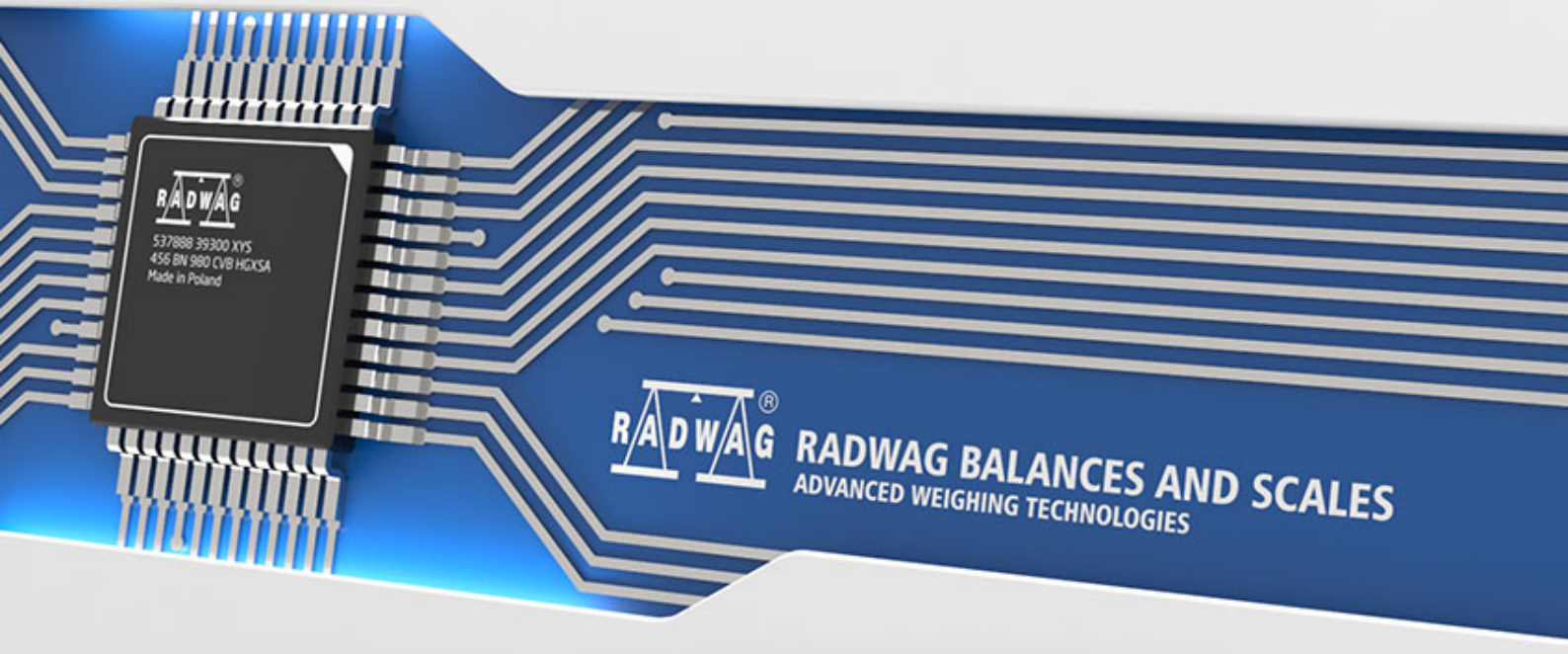
Application of MODBUS Protocol in RADWAG Indicators



MODBUS is one of the oldest and at the same time one of the most frequently used communication protocols intended for applications in industrial automation systems. It owes its popularity to its simplicity, versatility and inexpensive implementation. The protocol is based on a master-slave architecture, where a master device (e.g. a computer) communicates with one or more slaves. Communication consists of the master sending a request to all slaves connected to the network. Only one device, the one to which the message is addressed, responds. Communication can only be initiated by the Master device. The Slave device can only send a response to the request.

This manual describes the use of the *MODBUS* protocol by the HY10 weighing indicator. The indicator features two types of the protocol:

- *MODBUS RTU* – enables communication via RS232 serial connector
- *MODBUS TCP* – enables network communication via *Ethernet*

Content

1. IMPLEMENTED FUNCTIONS

The implemented protocol enables:

- Operation of up to 2 weighing platforms (mass readout, taring, zeroing, determining: tare value, LO, MIN and MAX thresholds of every platform),
- Input status readout,
- Output setting,
- Operator selection,
- Product selection,
- Customer selection,
- Packaging selection,
- Warehouse selection,
- Dosing selection,
- Formulations selection,
- Lot number selection,
- Process stop,
- Process start,
- Saving/Printout,
- Statistics zeroing.

MODBUS communciation is based on 3 functions:

- 03 (0x03) Read Holding Registers – output data readout,
- 04 (0x04) Read Input Registers – input data readout,
- 16 (0x10) Write Multiple Registers – output data record.

2. INPUT VARIABLES

Variable	Address	Length [WORD]	Data type
Platform 1 mass	0	2	float
Platform 1 tare	2	2	float
Platform 1 unit	4	1	word
Platform 1 status	5	1	word
Platform 1 LO threshold	6	2	float
Platform 2 mass	8	2	float
Platform 2 tare	10	2	float
Platform 2 unit	12	1	word
Platform 2 status	13	1	word
Platform 2 LO threshold	14	2	float
Process status (Stop, Start)	32	1	word
Input status	33	1	word
Min	34	2	float
Max	36	2	float
Lot number	42	2	dword
Operator	44	1	word
Product	45	1	word
Customer	46	1	word
Packaging	47	1	word
Source warehouse	48	1	word
Target warehouse	49	1	word
Formulation/Dosing	50	1	word

Platform mass – response: mass value of a given platform in current unit.
Platform tare – response: tare value of a given platform in adjustment unit
Platform unit – determines currently displayed mass unit of a given platform.

Unit bits	
0	gram [g]
1	kilogram [kg]
2	carat [ct]
3	pound [lb]
4	ounce [oz]
5	Newton [N]

Example:

Bit No.	B5	B4	B3	B2	B1	B0
Value	0	0	1	0	0	0

The unit of the weighing instrument is pound [lb]

Platform status – determines status of a given weighing platform.

Status bits	
0	Measurement correct (weighing instrument does not report an error).
1	Measurement stable.
2	Weighing instrument indicates zero.
3	Weighing instrument tared.
4	Weighing instrument in II weighing range.
5	Weighing instrument in III weighing range.
6	Weighing instrument reports NULL error.
7	Weighing instrument reports LH error.
8	Weighing instrument reports FULL error.

Example:

Bit No.	B8	B7	B6	B5	B4	B3	B2	B1	B0
Value	1	0	0	0	0	0	0	0	0

Weighing instrument reports FULL error.

LO threshold - response: **LO** threshold value in adjustment unit of a given platform.

Process status – determines process status:

Decimal value	**Process status**	**Bit No.**	
		B1	**B0**
0	Process disabled	0	0
1	Process start	0	1
2	Process stop	1	0
3	Process completed	1	1

Inputs status – response: status of set inputs:

Input No.	12	11	10	9	8	7	6	5	4	3	2	1
OFF	0	0	0	0	0	0	0	0	0	0	0	0
ON	1	1	1	1	1	1	1	1	1	1	1	1

Example: Mask of set input 2 and 4: 0000 0000 0000 1010

MIN – response: **MIN** threshold value (in the current unit selected for active working mode).

MAX – response: **MAX** threshold value (in the current unit selected for active working mode).

Serial number – returns the value of a serial number.

Operator – returns the value of a logged-in operator code.

Product – returns the value of a selected product code.

Customer – returns the value of a selected customer code.

Packaging – returns the value of a selected packaging code.

Source warehouse – returns the code of a selected source warehouse.

Target warehouse – returns the code of a selected target warehouse.

Formulation – returns the value of a selected formulation code.

3. OUTPUT VARIABLES

Variable	Address	Length [WORD]	Data type
Command	0	1	word
Command with parameter	1	1	word
Platform	2	1	word
Tare	3	2	float
LO threshold	5	2	float
Output state	7	1	word
Min	8	2	float
Max	10	2	float
Lot number	16	2	dword
Operator	18	1	word
Product	19	1	word
Customer	20	1	word
Packaging	21	1	word
Source warehouse	22	1	word
Target warehouse	23	1	word
Formulation/Dosing	24	1	word

Basic command – setting a respective value triggers direct performance of a given task, see the table:

Decimal value	Command
1	Zero the platform
2	Tare the platform
4	Clear statistics
8	Save/Print
16	Start
32	Stop (error)

Example: ·0000 0000 0010 0000 – response: process start.

Complex command – setting a respective value triggers performance of a given task, see the table:

Decimal value	Command
1	Setting tare value for a given platform
2	Setting LO threshold value for a given platform
3	Setting series number
4	Setting outputs state
5	Operator selection
6	Product selection
7	Packaging selection
8	Setting MIN threshold value
9	Customer selection
10	Source warehouse selection
11	Target warehouse selection
12	Dosing process selection
16	Setting MAX threshold value

A complex command requires the relevant parameter to be set (addresses 2 to 24 - see output variables table).

Platform – complex command parameter: weighing platform number.

Tare – complex command parameter: tare value (in an adjustment unit).

LO threshold – complex command parameter: LO threshold value (in an adjustment unit).

Output state – complex command parameter: status of weighing indicator outputs.

Output No.	12	11	10	9	8	7	6	5	4	3	2	1
OFF	0	0	0	0	0	0	0	0	0	0	0	0
ON	1	1	1	1	1	1	1	1	1	1	1	1

Example:
Mask of active output 2 and 4: 0000 0000 0000 1010

MIN – complex command parameter: MIN threshold value (in the unit set for the active working mode).

MAX – complex command parameter: MAX threshold value (in the unit set for the active working mode).

Serial number – complex command parameter: serial number value.

Operator – complex command parameter: code of logged in operator.

Product – complex command parameter: code of selected product.

Customer – complex command parameter: code of selected customer.

Packaging – complex command parameter: code of selected packaging.

Source warehouse – complex command parameter: code of selected source warehouse.

Target warehouse – complex command parameter: code of selected target warehouse.

Formulation – complex command parameter: code of selected formulation.

A command or a command with parameter is executed once when its bit setting is detected. If the command with the same bit is to be executed again, zero the bit.

Example:

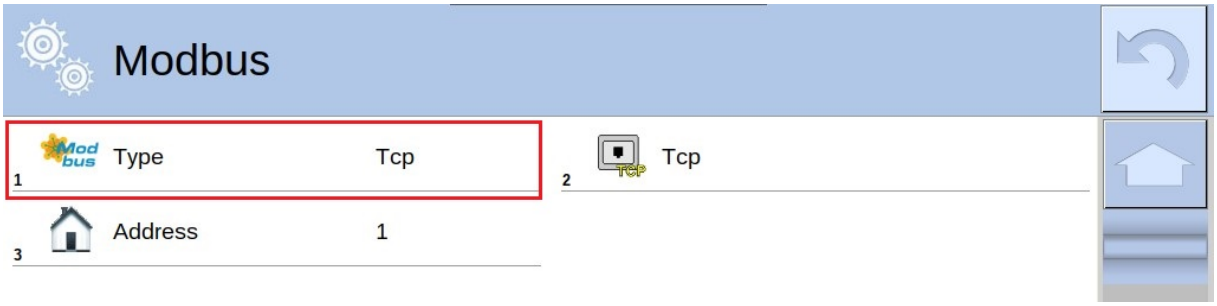
Command	**Address 1**	**Address 0**
Taring	0000 0000	0000 0010
Command bit zeroing	0000 0000	0000 0000
Taring	0000 0000	0000 0010

The presented examples use the *MODBUS TCP* protocol. Communication takes place between the computer (master) and the HY 10 weighing indicator (slave), which is connected to the network via an *Ethernet* cable. *Modbus Poll* was used to simulate the data exchange. It is a program designed primarily to support developers of Modbus slaves or others who want to test and simulate the Modbus protocol. The link below directs you to the manufacturer's website, where you can download the program. You can use the program for free for the first 30 days. After this time, you must purchase a license.

https://www.modbustools.com/

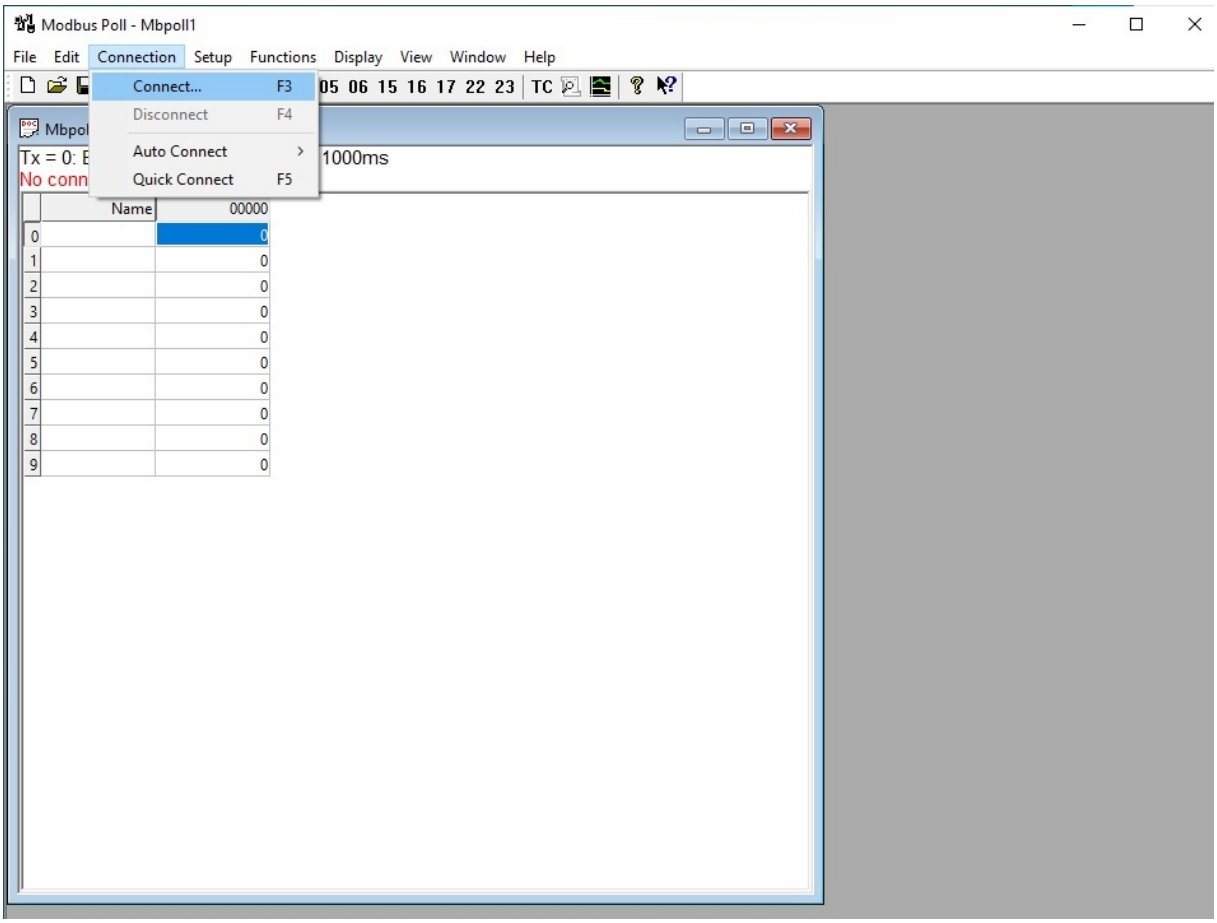
4. SETUP

Once the indicator is connected to the Internet, the transmission type must be set. To do this, select *Setup →Peripherals →Modbus →Type* on the indicator screen and change the value to *TCP*.

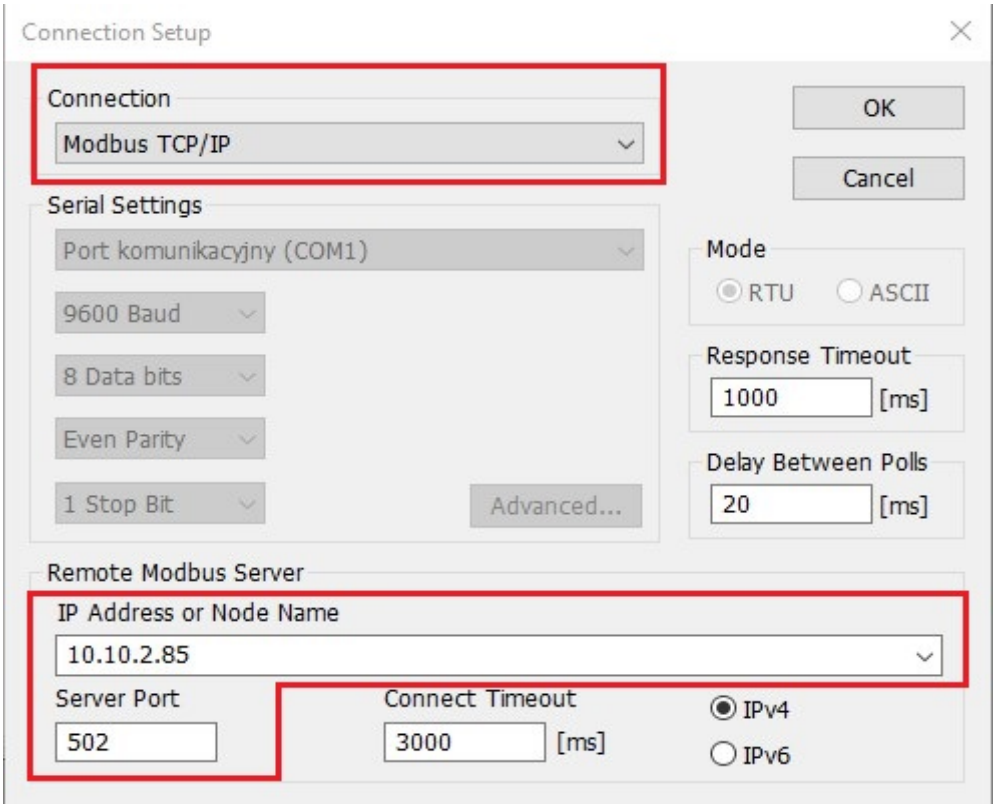


The TCP port number has a default value of 502.

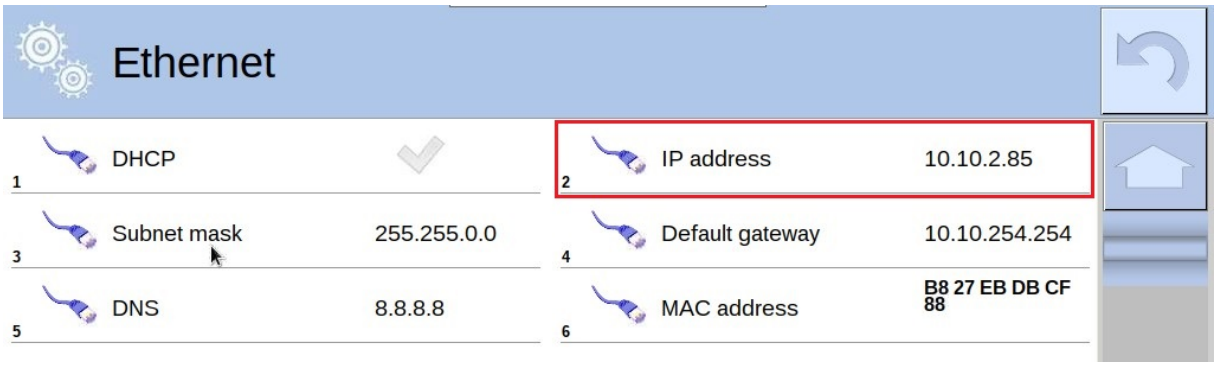
After correct configuration of the slave device, which is the indicator, move on to the *Modbus Poll* program. Upon start, press *Connect*, as presented below.



A window for connection setup is displayed. In this case, we use the TCP interface. In *Connection* menu select *Modbus TCP/IP*. Next, in *IP Address or Node Name* enter IP address of the device that you will connect with and in *Server Port* enter the port number.



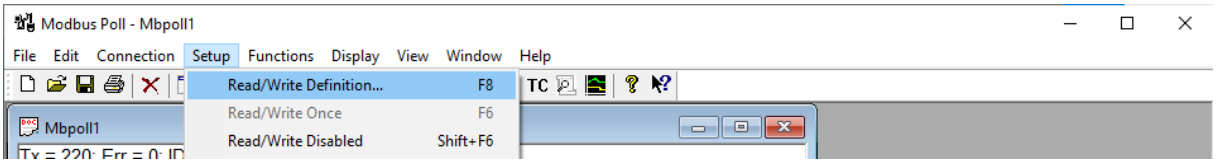
The IP address can be found in the indicator settings: *Setup→ Communication →Ethernet*



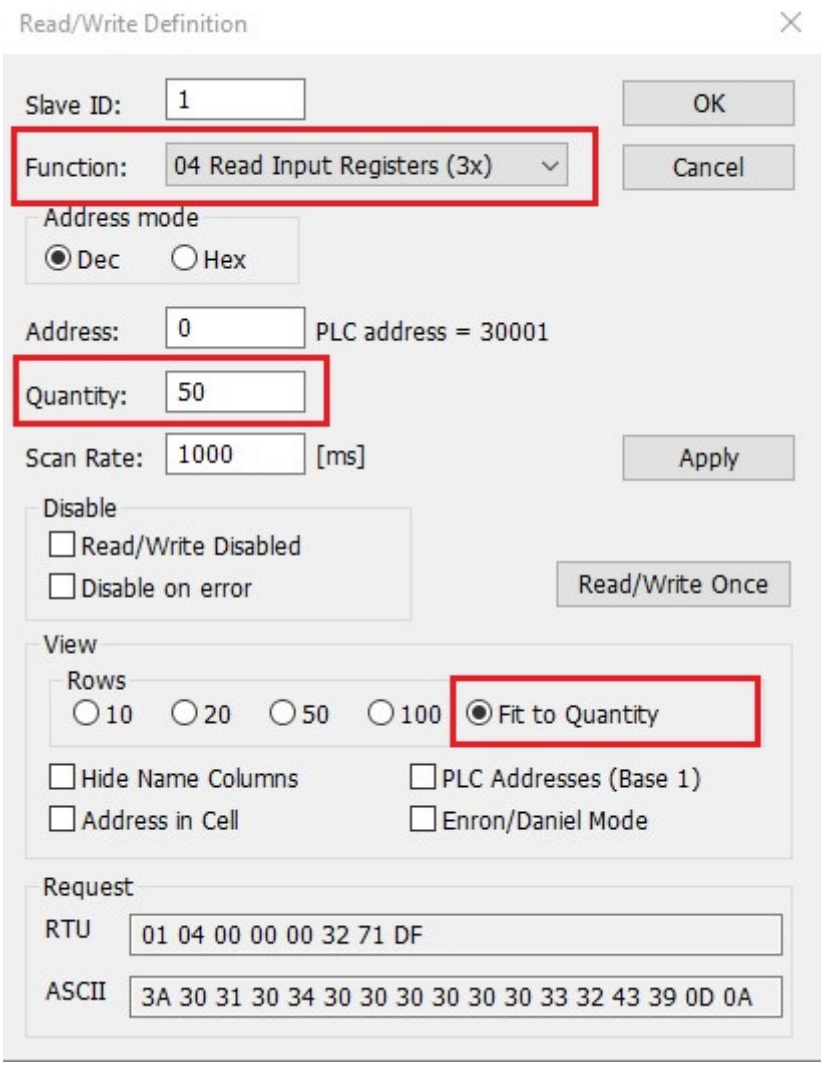
As previously mentioned, the port number is set to 502 by default. To change it, select *Setup→ Peripherals→ Modbus→ Tcp* in the indicator

Confirm introduced modifications by pressing *OK*.

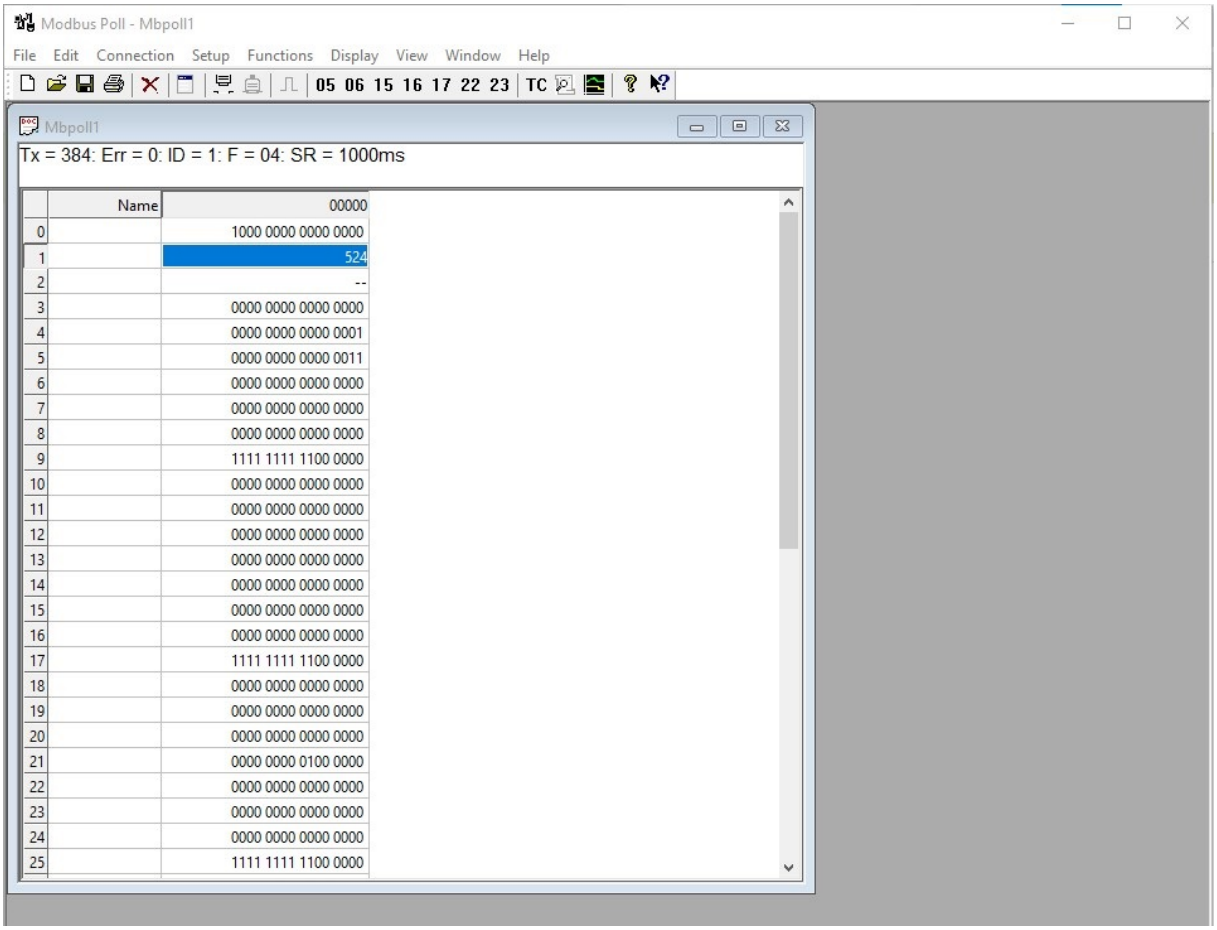
Next, move on to program settings. Press *Setup* → *Read/Write Definition*.



In the new window, select and enter what is highlighted in the image below. Confirm introduced modifications by pressing *OK*.



A table with the data sent by the HY 10 indicator is displayed in the main menu of the program.

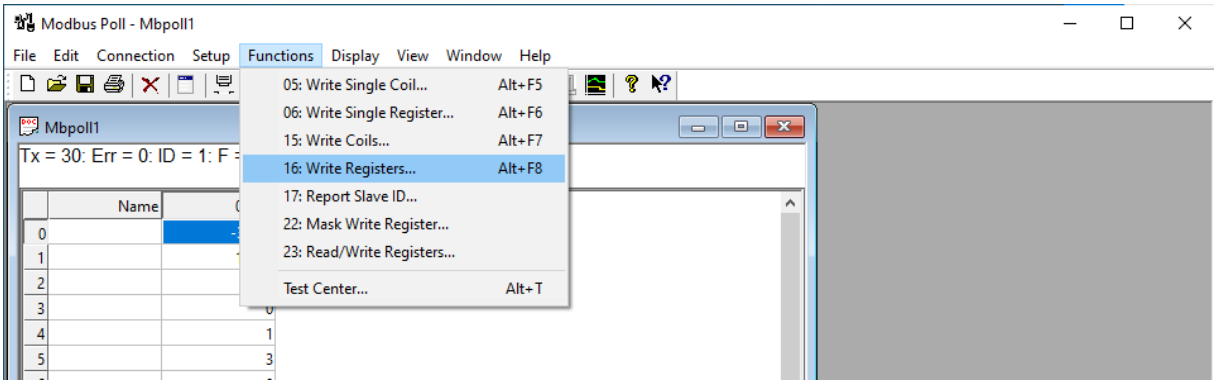


The numbers on the left correspond to the addresses in the input variables table. From the above photo you are able to read:

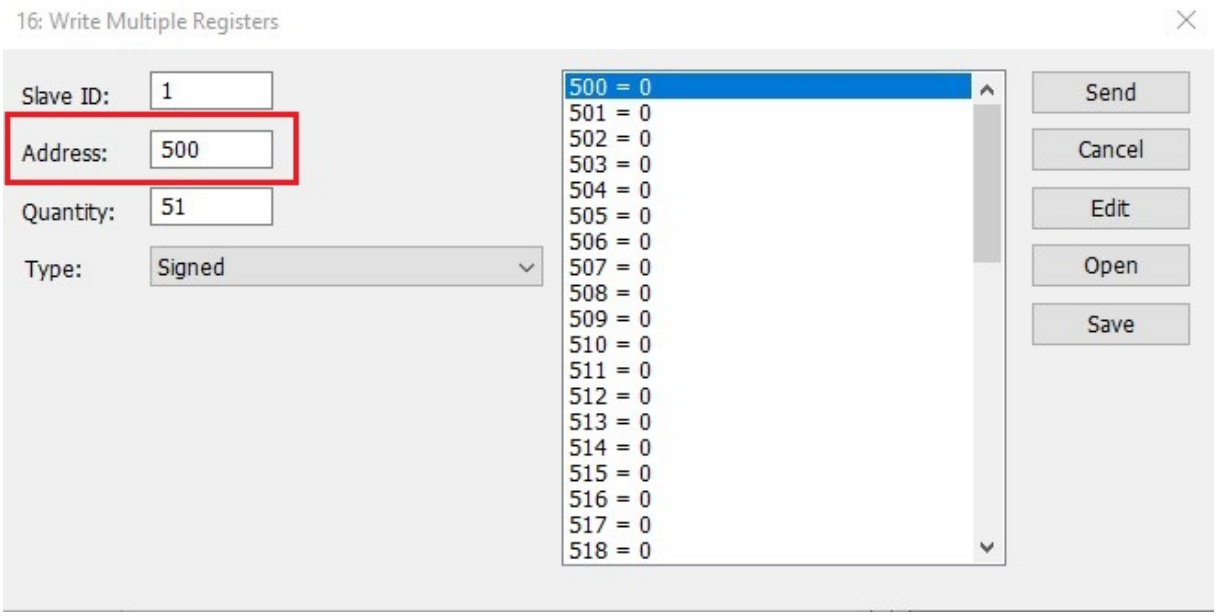
- mass from address 1 (524),
- platform unit from address 4 (g),
- platform status from address 5 (the weighing instrument does not report any error, measurement is stable)

The format in which you want to display the data can be changed in the *Display* tab. In the image above, the data is displayed mainly in binary form.

To send a data message to the indicator, select *Functions →Write Registers* in the *Modbus Poll* main window or *alt + F8* on the keyboard.



A window for filling in the data as below is opened.

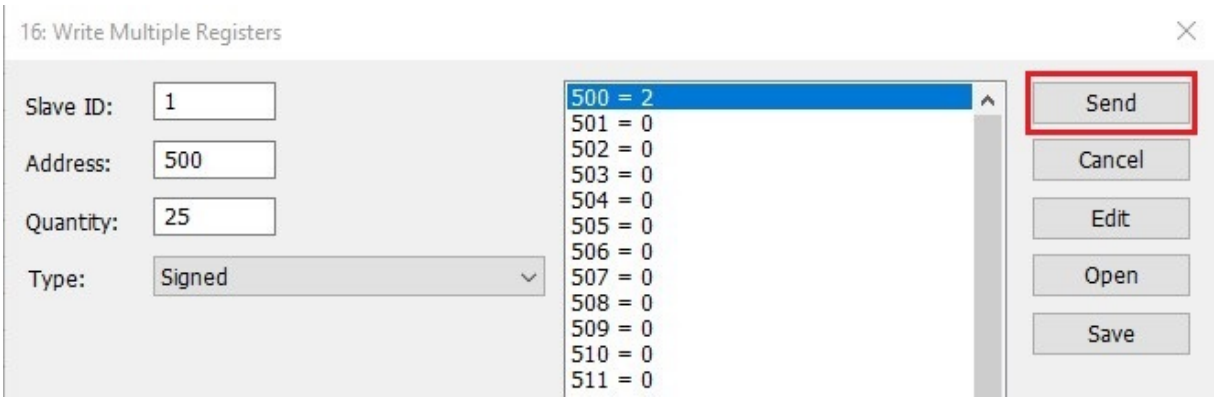


5. EXAMPLES

If you want to send a message to the weighing instrument, refer to the table of output variables. Enter the respective values from the table above in the relevant fields in the program. To send message press *Send*. If the communication was successful, you will receive a message as in the picture below. The following subsections show some examples of communication with the HY 10 indicator.

5.1 Taring

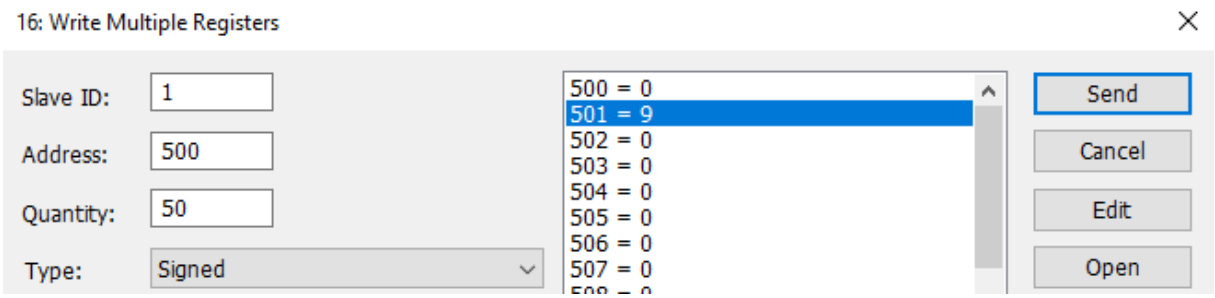
To tare the platform use the basic command. In the address field of this command enter the decimal value corresponding to the tare, i.e. 2, and press *Send*.

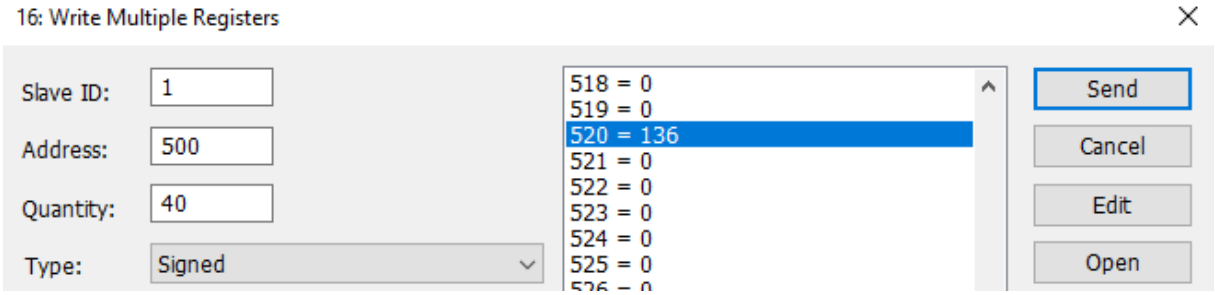


If the transmission is successful, the weighing instrument is tared.

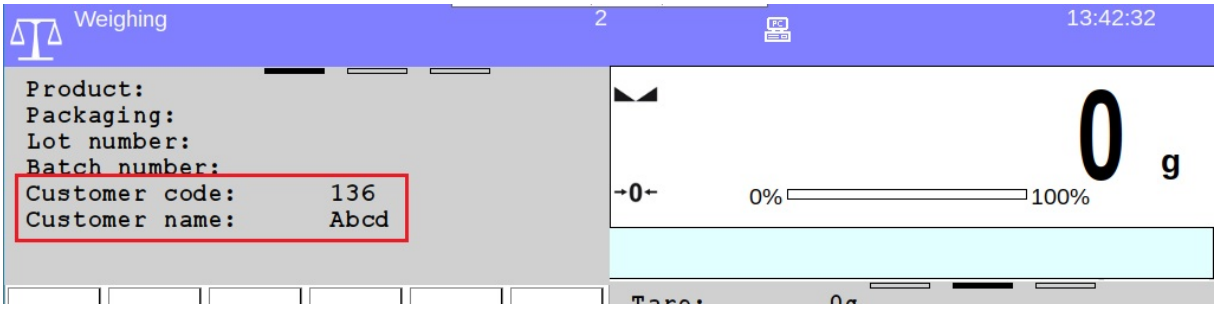
5.2 Customer Selection

To select a customer set respective decimal value of the complex command in the address of a command with parameter, in this case 9. Then in the output variables table check the address for the customer, it is 20. Go back to the *Modbus Poll*, find the address field and enter the code assigned to a given customer.



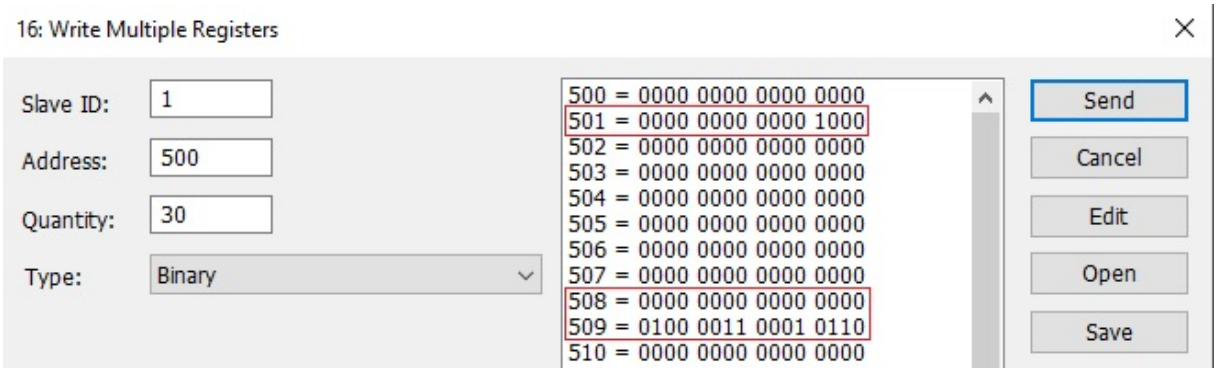


After completing the above fields, press *Send*. A message is sent to the device to set up a customer with code 136. If there are no errors in transmission you will receive a *Response ok* message and the selected customer will be set. To confirm, check indicator's screen. Of course, a customer with the given code must be in the weighing instrument database.

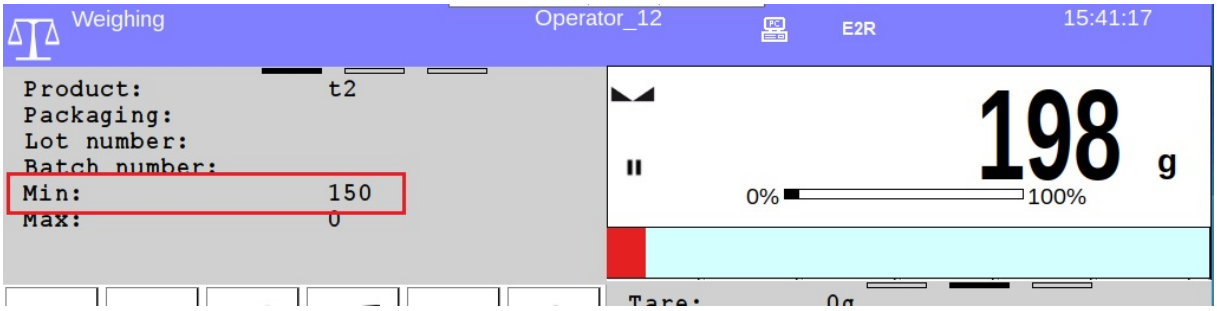


5.3 Setting MIN Threshold

In the presented example, the min value is set to 150 using a binary code. Check the decimal value of the complex command corresponding to the Min threshold setting and change it to binary form. In the output variables table check the address of the Min value. Enter the number in binary form in the appropriate field in the program window. A number can be easily converted to binary using free converters available on the Internet.

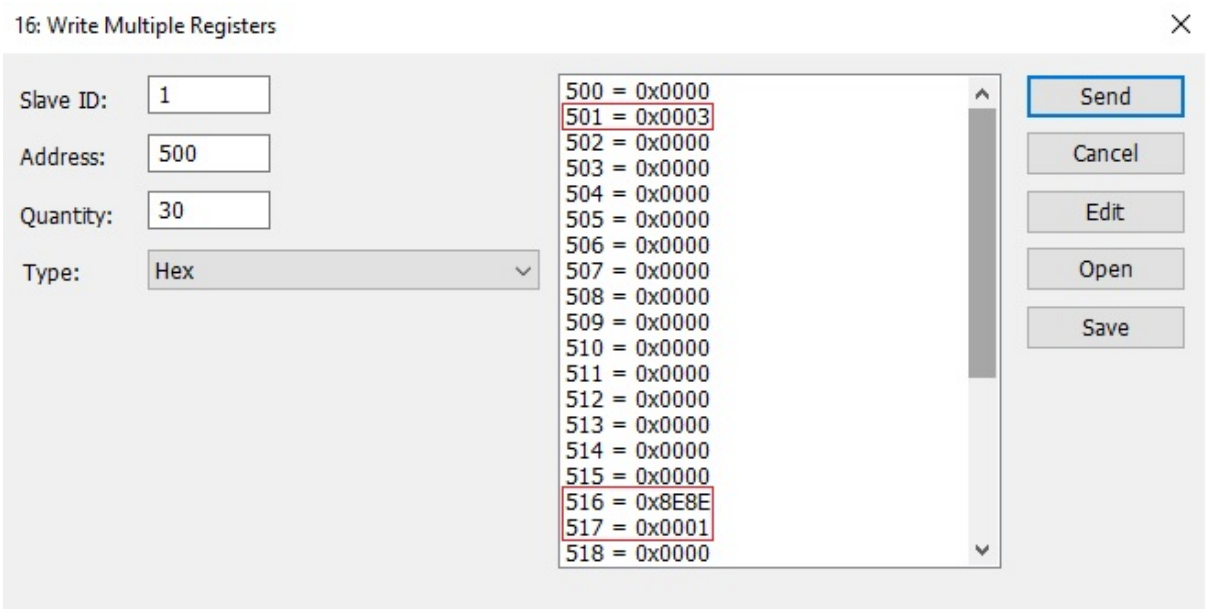


In the picture below, a confirmation of successful communication with the HY 10 indicator is presented.

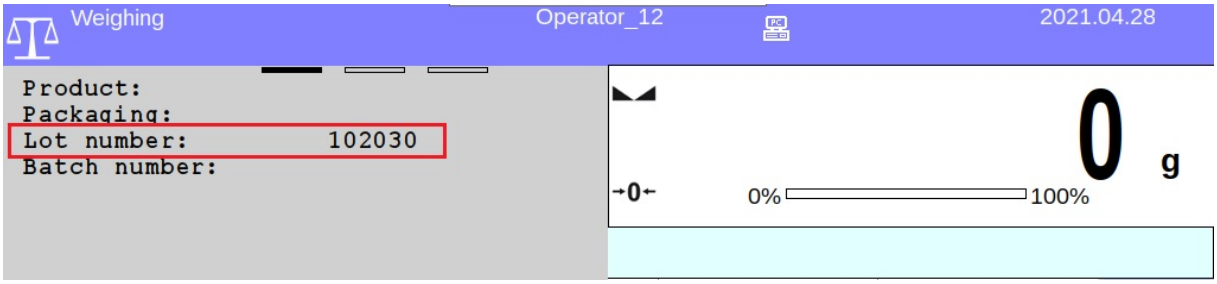


5.4 Setting Lot Number

To set the lot number of weighed product to 102030, follow the next steps. In this example we use the code in a hexadecimal form. In the address field of the complex command, enter the respective decimal value corresponding to the setting of the lot number. Next, in the output variables table find the address being a lot number. Fill in all the fields as presented below.



As a result of the message, the lot number is set.



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