

SPECIFICATIONS



***Differential pressure transmitter
DPC6000-M-V (MODBUS, 0-10V)
DPC6000-M (MODBUS)***

Prepared by:
HOTCOLD s.c.

2025-10-03

1.	Introduction.....	3
1.1.	Functions.....	3
1.2.	Characteristics.....	3
1.3.	Worth knowing.....	3
2.	Technical data.....	4
2.1.	General parameters.....	4
2.2.	Differential pressure measurement parameters.....	4
2.3.	Analogue output parameters.....	4
2.4.	Serial interface parameters.....	4
3.	Installation.....	5
3.1.	Safety.....	5
3.2.	Unit design.....	5
3.3.	Description of Connections.....	6
3.4.	Analogue output configuration.....	6
3.5.	Address setup.....	6
3.6.	Offset zeroing.....	7
3.7.	Restoring factory settings.....	7
3.8.	Guidelines.....	7
4.	MODBUS protocol.....	9
4.1.	Map of registers.....	9
4.2.	Protocol functions.....	10
4.2.1.	Reading the contents of the output register group (0x03).....	11
4.2.2.	Entry to the output register group (0x10).....	11
4.3.	Data format.....	12
4.4.	CRC checksum.....	13
4.4.1.	Bit CRC counting algorithm:.....	13
4.4.2.	CRC counting array algorithm:.....	13

1. Introduction

The subject of this study is the functional characteristics of a differential pressure transmitter based on a Honeywell ABP series pressure sensor, type **DPC6000-M-V** with an RS-485 interface with a built-in MODBUS RTU protocol and a 0-10V analog output, and type **DPC6000-M** with an RS-485 interface with a built-in MODBUS RTU protocol.

CAUTION: Before starting the unit, please read the content of this document.

1.1. Functions

- differential pressure measurement (range depending on the sensor used)
- analogue voltage output 0-10 [V] (proportional to pressure difference)
- output range configuration
- measurement time constant configuration
- sensor offset zeroing function
- LED unit status indication
- serial interface RS-485 (reading of measurement values, setup of operating parameters)
 - MODBUS RTU protocol
 - communication in HALF DUPLEX mode
 - hardware configurable address (1-31)

1.2. Characteristics

The primary function of the DPC6000-M-V and DPC6000-M series transmitters is differential pressure measurement. Values measured via the integrated Honeywell ABP series sensor, then converted and averaged in the microcontroller, are available in its memory (in holding registers) according to the MODBUS standard. Registers are read using MODBUS protocol functions transmitted via the RS-485 serial interface, and in devices with a 0-10V output, linearly proportional to the reading range. Information about the currently set (configurable) measurement range, time constant (also configurable), and percentage of the pressure value relative to the range is also available in the registers. Sensor absence, measurement range overflow, and transmitter occupancy during offset calibration are also signaled via status registers.

1.3. Worth knowing

1 hPa = 100 Pa = 1 mbar
1 inH₂O = 249.089 Pa

2. Technical data

2.1. General parameters

Power	
- DC	DC 24V (20...30V)
- AC	AC 24V (21.5...26.5V)
Current consumption	
- minimum ¹⁾	9.0 mA
- typical ²⁾	11.0 mA
- maximum ³⁾	22.0 mA
LED signaling	0.2 Hz
Installation connector	screwed in raster 5.00mm ($\leq 2.5\text{mm}^2$)
Dimensions	112 x 84 x 31 (L x H x W)
Weight	approx. 100 g.
Mount ⁴⁾	wall mounted
Degree of protection	IP65
Operating environment	dust-free, air, neutral gases
Operating temperature	-20°C ÷ 50°C
Storage conditions	
- temperature	-40°C ÷ 85°C
- relative humidity	20 ÷ 60 %RH

1) Average current consumption of the device under the following conditions: no transmission; unloaded analog output; 24V DC power supply;

2) Average current consumption of the device under the following conditions: transmission of 10 b/s; transmission rate 9600 b/s; simultaneous reading of 20 registers; bus terminating resistors 2 x 120Ω; analog output set to 10V and loaded with 10kΩ resistance; 24V DC power supply;

3) Maximum instantaneous current consumption under conditions: analogue output with 1kΩ resistance; signaling LED always on; other conditions as in 2);

4) The unit must be installed by qualified personnel;

2.2. Differential pressure measurement parameters

Sensor type	ABP
Measuring range	up to -6000...6000 Pa
Resolution	12 bits
Accuracy:	
- within 0 ÷ 50°C	±0,25% of range
- within -20 ÷ 85°C	unspecified
Sampling rate	100 Hz
Response time ¹⁾	0.8s/ 4s)

1) specified response time is equal to one time constant corresponding to 63% of the fixed value;

2) the default value is the shorter response time;

2.3. Analogue output parameters

Output type	voltage
Output range	0 - 10 V
Resolution	12 bits (5 mV)
Load capacity	$R_L > 1\text{ k}\Omega$
Frequency of refreshment	100 Hz

2.4. Serial interface parameters

Physical layer	RS-485
Communication protocol	MODBUS RTU
Connection configuration ¹⁾	HALF DUPLEX
Transmission rate	9600 / 19200 / 57600 / 115200 b/s

1) HALF DUPLEX - two-way communication with one cable pair;

3. Installation

3.1. Safety

- The unit must be installed by qualified personnel!
- All connections must be made according to the wiring diagrams shown in this specification!
- Check all electrical connections before starting up!

3.2. Unit design

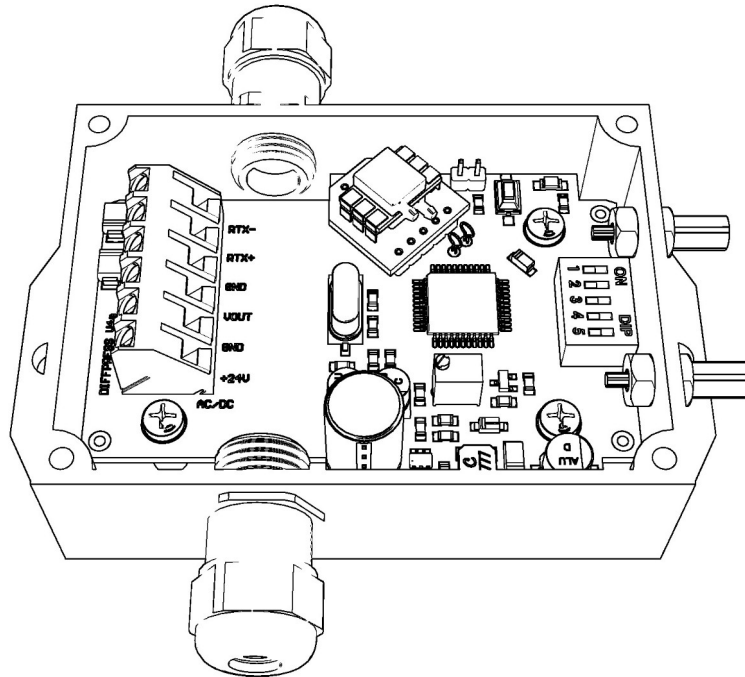


Figure 1. View of PCB.

3.3. Description of Connections

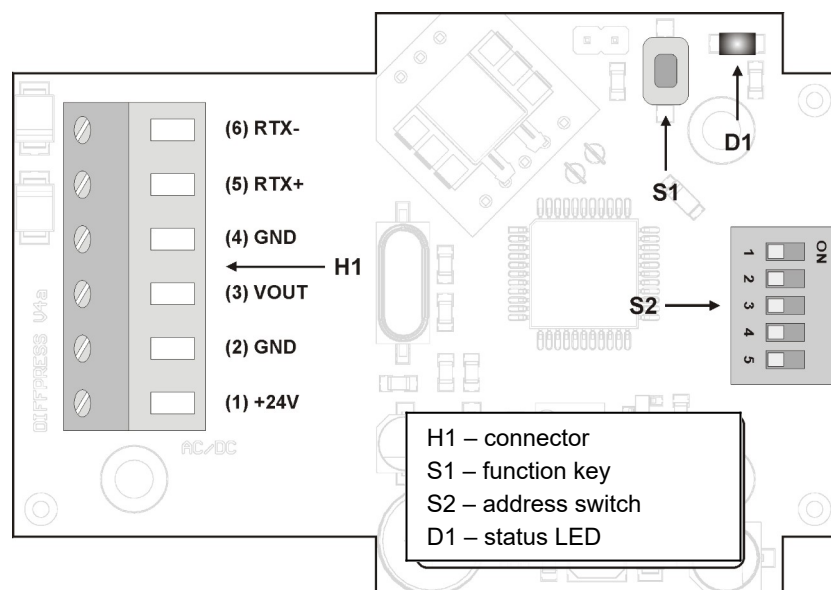


Figure 2. Transmitter leads description.

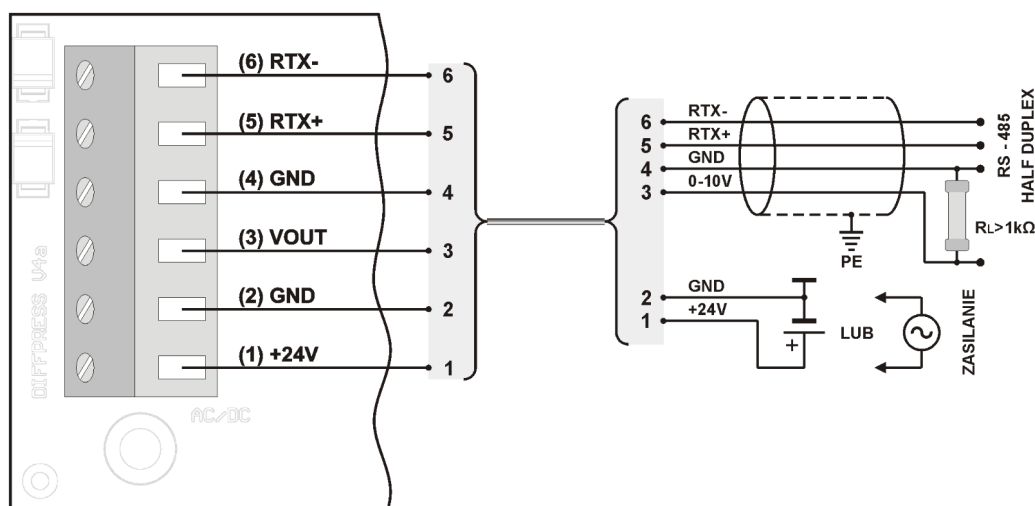


Figure 3. Wiring diagram.

3.4. Analogue output configuration

The unit is equipped with an analogue output: voltage range from 0 to 10V. Depending on the selected range, the device at the outlet displays a value proportional to the measured differential pressure. Measurement results are averaged and refreshed at the outputs according to a set time constant.

3.5. Address setup

The device is equipped with a 5-position switch for address setup by hardware (from "1" to "31"). Set the address "0" on the switch to use the address stored in the device via MODBUS protocol (default "1").

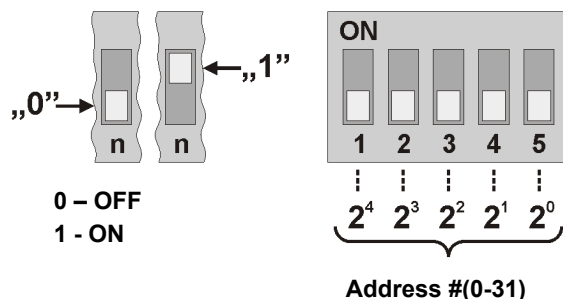


Figure 4. Addressing the transmitter.

3.6. Offset zeroing

Zero command:

Before calibrating (zeroing) the offset, the output range must be set beforehand and both connectors must have the same pressure (you may disconnect both hoses). The zeroing process takes place after sending the offset calibration command. The calibration time is about 7s. After correct calibration the device should indicate zero pressure.

Zero button:

Before calibrating (zeroing) the offset, the output range must be set beforehand and both connectors must have the same pressure (you may disconnect both hoses). To trigger the zeroing process, press and hold S1 button for approximately 3 seconds until D1 starts flashing. The calibration time is counted from the moment the button is released and it takes about 7 seconds. Calibration process is indicated by the blinking of D1 LED. After correct calibration the device should indicate zero pressure.

3.7. Restoring factory settings

The factory settings reset function only applies to the transmission parameters of the RS-485 interface (including address). To restore the settings, press and hold S1 button for about 10 seconds (D1 LED is lit for first 3 seconds, then it blinks for 7 seconds). Release the button when D1 LED is steady lit again. The unit will start working with the new settings automatically.

3.8. Guidelines

- Use shielded cables when working in a highly noisy environment.
- Connect the cable screed to the nearest PE point on the power supply side.

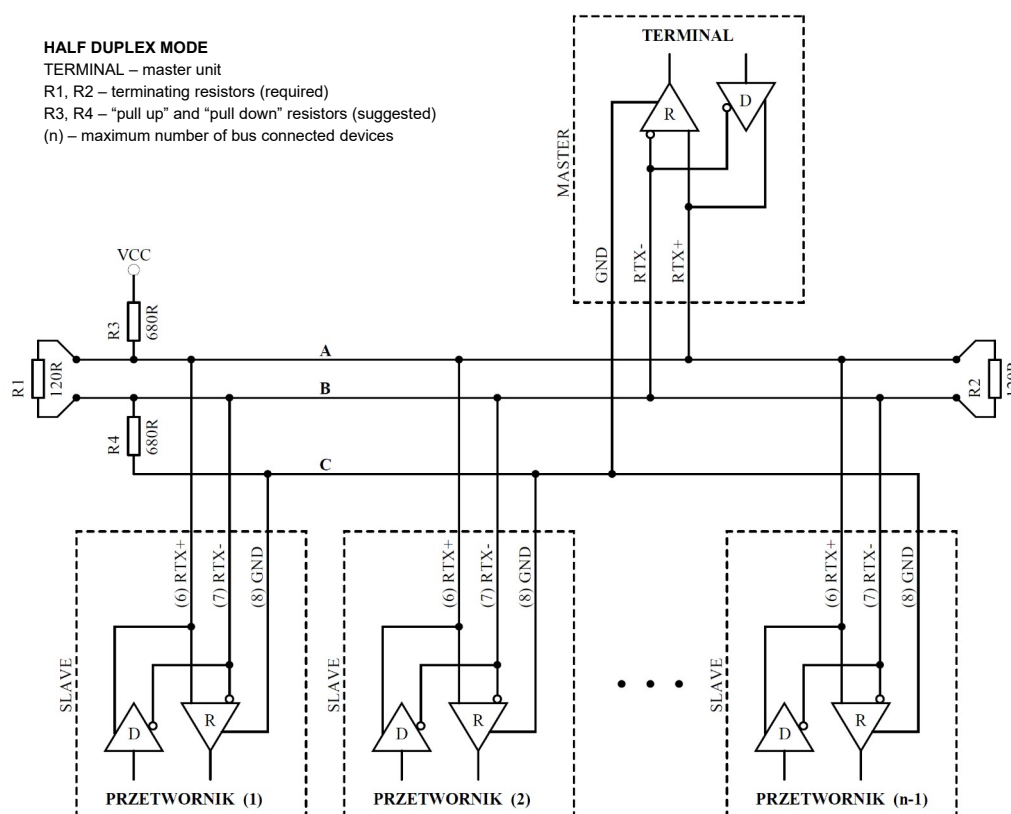


Figure 5. Connection of the transmitter to the RS-485 bus operating in HALF DUPLEX mode.

4. MODBUS protocol

4.1. Map of registers

Table of registers:

Register no.	Values	Description
1	-9999 - 9999	Differential pressure (limited by measuring range) [Pa] (1 = 1 Pa) with sign
2	0 - 1000	Differential pressure related to range (1 = 0.1%; 1000 = 100%)
3	0 / 1 / 2 / 3	Status log (0: "SENSOR OK", 1: "UNDERLOAD", 2: "OVERLOAD", 3: "NO SENSOR") (*)
4	1234	Password log
5	1 / 2 / 3	Command log
6	as per command table	Parameter log
7	0 / 1	TAU time constant (0: 0.8s; 1: 4.0s)
8	0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10 / 11 / 12 / 13	Measuring range (according to table of measuring ranges)
9	-9999 - 9999	Transmitter offset (informative) [Pa] (1 = 1 Pa) with sign
10	-9999 - 9999	Lower value of the measuring range (informative) [Pa] (1 = 1 Pa) with sign
11	-9999 - 9999	Upper value of the measuring range (informative) [Pa] (1 = 1 Pa) with sign
12	0 / 1	Offset calibration (zeroing) status (0: not active; 1: in progress)
13	0-65535	Counter of correct frames
14	0-65535	Exception counter
15	0-65535	CRC error counter
16	0-65535	Byte error counter
17	0-65535	Address error counter

(*) "SENSOR OK" - correct functioning of the sensor; "UNDERLOAD" - exceeded lower limit;

"OVERLOAD" - exceeded upper limit; "NO SENSOR" - sensor is missing;

Command table:

Comm and no.	Function	Parameter
1	Set device address	1 - 247 (1-default value)
2	Set transmission rate	96 - 9600 b/s (default value) 192 – 19200 b/s 576 – 57600 b/s 1152 – 115200 b/s
3	Set parity	0 - NO PARITY; no parity bit 1 - EVEN PARITY; (default value) 2 – ODD PARITY,
4	Set stop bits	1 - 1 x STOP; 1 stop bit (default value) 2 - 2 x STOP; 2 stop bits

5	Set time constant	0 – 0.8s; 1 – 4.0s;
6	Set measuring range	ID according to table of measuring ranges)
7	Start calibration process	1- start offset calibration (zeroing)
8	Device reset	1 - software device reset

Table of measuring ranges:

Range		Pressure values → voltage output		
ID	0 – 6000 [Pa]	0V	5V	10V
0	0 : 6000	0 Pa = 0V	3000 Pa = 5V	6000 Pa = 10V
1	0 : 4000	0 Pa = 0V	2000 Pa = 5V	4000 Pa = 10V
2	0 : 2500	0 Pa = 0V	1250 Pa = 5V	2500 Pa = 10V
3	0 : 2000	0 Pa = 0V	1000 Pa = 5V	2000 Pa = 10V
4	0 : 1500	0 Pa = 0V	750 Pa = 5V	1500 Pa = 10V
5	0 : 1000	0 Pa = 0V	500 Pa = 5V	1000 Pa = 10V
6	0 : 500	0 Pa = 0V	250 Pa = 5V	500 Pa = 10V
7	-6000 : 6000	-6000 Pa = 0V	0 Pa = 5V	6000 Pa = 10V
8	-4000 : 4000	-4000 Pa = 0V	0 Pa = 5V	4000 Pa = 10V
9	-2500 : 2500	-2500 Pa = 0V	0 Pa = 5V	2500 Pa = 10V
10	-2000 : 2000	-2000 Pa = 0V	0 Pa = 5V	2000 Pa = 10V
11	-1500 : 1500	-1500 Pa = 0V	0 Pa = 5V	1500 Pa = 10V
12	-1000 : 1000	-1000 Pa = 0V	0 Pa = 5V	1000 Pa = 10V
13	-500 : 500	-500 Pa = 0V	0 Pa = 5V	500 Pa = 10V

Notes:

- If you input wrong or out of range parameter value, the value of 0xEEEE shall be entered in the command register.
- Each time the command is called, it must be accompanied by a password (1234 decimal).
- Calling the command through individual registry entries, must be completed by entering the password.

4.2. Protocol functions

The following MODBUS functions are implemented in DIFFPRESS v2 transmitter:

CODE	DESCRIPTION
03 (0x03)	N reading x 16-bit registers
16 (0x10)	N writing x 16-bit registers

4.2.1. Reading the contents of the output register group (0x03)

Request format:

Description	Size	Values
Unit address	1 byte	1 – 247 (0xF7)
Function code	1 byte	0x03
Data block address	2 bytes	0x0000 – 0xFFFF
Number of registers (N)	2 bytes	1 – 125 (0x7D)
CRC checksum	2 bytes	as calculated

Response format:

Description	Size	Values
Unit address	1 byte	1 – 247 (0xF7)
Function code	1 byte	0x03
Byte counter	1 bytes	2 x N
Registry values	N x 2 bytes	per register map
CRC checksum	2 bytes	as calculated

Error format:

Description	Size	Values
Unit address	1 byte	1 – 247 (0xF7)
Function code	1 byte	0x83
Error code	1 byte	0x01 / 0x02 / 0x03 / 0x04
CRC checksum	2 bytes	as calculated

4.2.2. Entry to the output register group (0x10)

Request format:

Description	Size	Values
Unit address	1 byte	1 – 247 (0xF7)
Function code	1 byte	0x10
Data block address	2 bytes	0x0000 – 0xFFFF
Number of registers (N)	2 bytes	1 – 123 (0x7B)
Byte counter	1 byte	2 x N
Values	N x 2 user bytes	
CRC checksum	2 bytes	as calculated

Response format:

Description	Size	Values
Unit address	1 byte	1 – 247 (0xF7)
Function code	1 byte	0x10
Data block address	2 bytes	0x0000 – 0xFFFF
Number of registers (N)	2 bytes	1 – 123 (0x7B)
CRC checksum	2 bytes	as calculated

Error format:

Description	Size	Values
Unit address	1 byte	1 – 247 (0xF7)
Function code	1 byte	0x90
Error code	1 byte	0x01 / 0x02 / 0x03 / 0x04
CRC checksum	2 bytes	as calculated

4.3. Data format

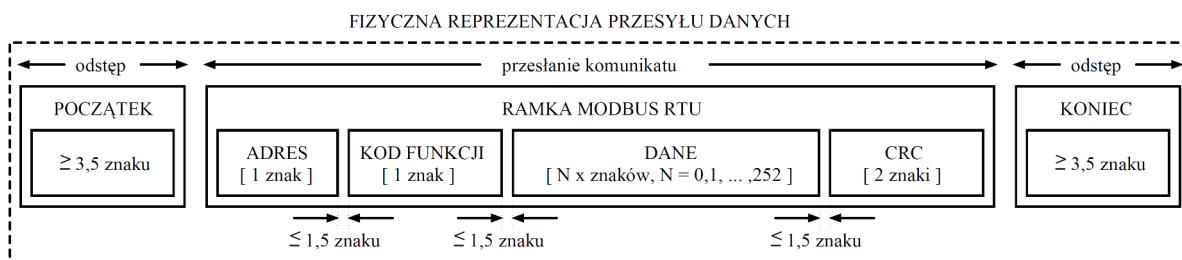


Figure 6. MODBUS RTU standard data transmission implemented in the transmitter.

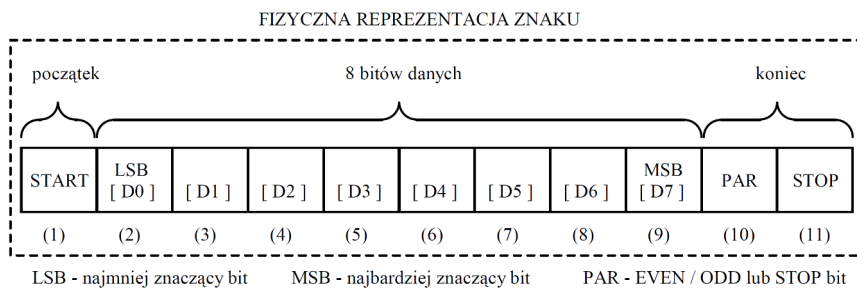


Figure 7. MODBUS RTU standard character format used in the transmitter.

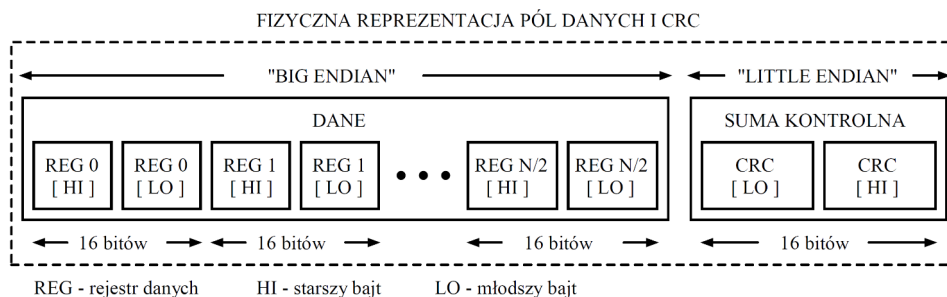


Figure 8. Data field format and CRC in MODBUS RTU standard used in the transmitter.

4.4. CRC checksum

According to the MODBUS standard, a polynomial was used to calculate the CRC checksum:
 $X^{16} + X^{15} + X^2 + 1$.

4.4.1. Bit CRC counting algorithm:

Procedure for determining the CRC checksum by bit:

- a) loading 0xFFFF value into 16-bit CRC register;
- b) taking the first byte from the data block and performing the EX-OR operation with the younger CRC register byte, placing the result in the register;
- c) shift contents of the CRC registry to the right by one bit in the direction of the least significant bit (LSB), zeroing of the most significant bit (MSB);
- d) check the state of the youngest bit (LSB) in the CRC register, if its state is 0, then the return to point c, if 1, then the EX-OR operation of the CRC register with the constant 0xA001 is performed;
- e) repeat steps c and d up to eight times, which corresponds to processing the whole byte;
- f) repeat the sequence b, c, d, e for the next byte of the message, continue this process until all bytes of the message have been processed;
- g) content of the CRC register after the execution of the listed operations is the value of the CRC checksum sought;
- h) addition of the CRC checksum to the MODBUS RTU frame must be preceded by replacing the older and younger byte of the CRC register.

4.4.2. CRC counting array algorithm:

Example procedure for determining the CRC with array method:

```
/* The function returns the CRC as a unsigned short type */
unsigned short CRC16 ( puchMsg, usDataLen )
/* message to calculate CRC upon */
unsigned char *puchMsg ;
/* quantity of bytes in message */
unsigned short usDataLen ;

{
    /* high byte of CRC initialized */
    unsigned char uchCRCHi = 0xFF ;
    /* low byte of CRC initialized */
    unsigned char uchCRCLo = 0xFF ;
    /* will index into CRC lookup table */
    unsigned uIndex ;

    /* pass through message buffer */
    while (usDataLen--)
    {
        /* calculate the CRC */
        uIndex = uchCRCLo ^ *puchMsg++ ;
        uchCRCLo = uchCRCHi ^ auchCRCHi[uIndex] ;
        uchCRCHi = auchCRCLo[uIndex] ;
    }
    return (uchCRCHi << 8 | uchCRCLo) ;
}
```

