



User Manual

DMS100

Modbus RTU RS485 Sensor

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Note: The specifications in this document are valid as of the listed versions of software and/or hardware. Revised versions of this document, as well as software and driver updates are available in the download area of the Decode web site.

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1 Preface

1.1 Symbols



WARNING - Safety notice, which must be followed, may have influence on the user's safety or the function of the device.



IMPORTANT - Notice, which must be followed to avoid possible problems, which can arise in specific cases.



NOTE - Notice, which contains useful advice.

1.2 Safety Instructions

Device must be used in compliance with any and all applicable international and national laws and in compliance with special restrictions regulating the utilization of the communications of the communication module in prescribed applications and environments.



WARNING - We suggest you to adhere to following recommendations so as to avoid any damage to person or property.

- **All the associated (interconnected) equipment, PC and power supply units (PSU) shell comply with requirements of standard IEC 60950- 1:2005+A1:2009+A2:2013.**
- **Power supply must have SELV output and for security reasons connection must include series 1A fuse protection.**
- **Access to terminal block connections must be checked and restricted in the end installation using potential hazardous voltage.**
- **Installation and technical support of the device can be performed only by a qualified personnel or a person who has enough knowledge about this device and safety requirements.**
- **Unauthorized modifications or utilization of accessories that have not been approved may result in damage to the device and in a breach of applicable regulations, and result in the termination of the validity of the guarantee.**
- **Do not expose the device to extreme ambient conditions. Protect the device against dust, moisture and high temperature.**

1.3 Document versions

Document version	Version FW / HW	Date	Note
v1.0	v1.00 / Rev. 160120	01/04/2020	Initial version
v1.1	v1.00 / Rev. 160120	28/10/2020	Typo changes

2 Description

DMS100 series devices are RS485 Modbus RTU sensors with unlimited application potential. Due to its simplicity, the Modbus protocol is a widely used method of communication for sensing and automation. DMS100 are used for environmental monitoring, agriculture, smart buildings, health care and so on. They are wired with a twisted pair cable for transferring power and data. Small OLED display shows latest measuring results. User buttons are used for easy setup of devices in the field. Wide supply voltage range from 4.5V to 28V makes possible to use 5V supply voltage, from USB for example, and also 24V supply voltage typically found in industry. Thanks to its low power and small bus loading, up to 200 units may be attached to the single twisted pair cable more than 1km long. Accessing sensors from computers or gateways without RS485 interface is easy with DSH105 series sensor hub devices, using available interfaces such as USB, Ethernet or WiFi.

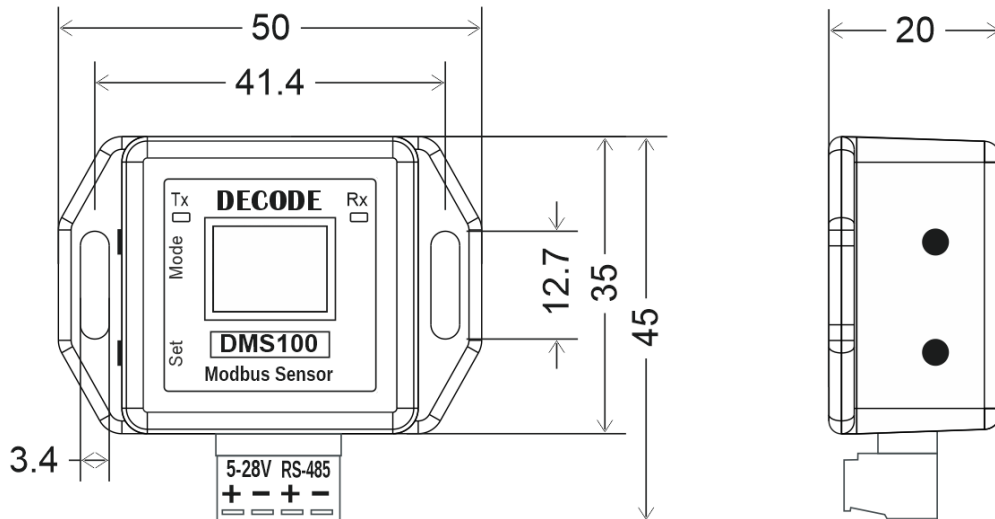


Picture 1: Decode DMS100

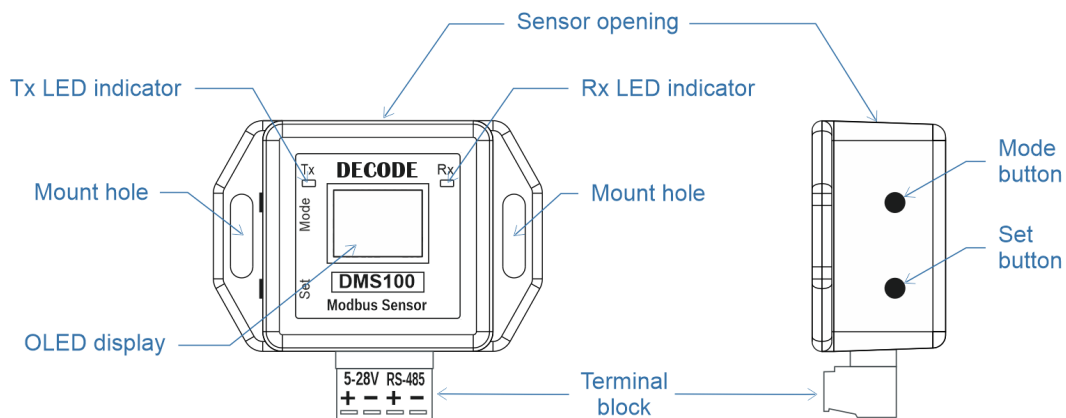
Different sensor types are available with several physical quantities. Some devices are single physical sensor while others are combining multiple quantities in a single device. Sensor name consists of the device family name plus the sensor type number. For example DMS101 is name for DMS100 series NTC temperature sensor with 01 sensor type number.

3 Installation

Device can be installed on wall, plate or pole using double sided self adhesive tape, screws or cable ties.



Picture 2: Dimensions



Picture 3: Main parts



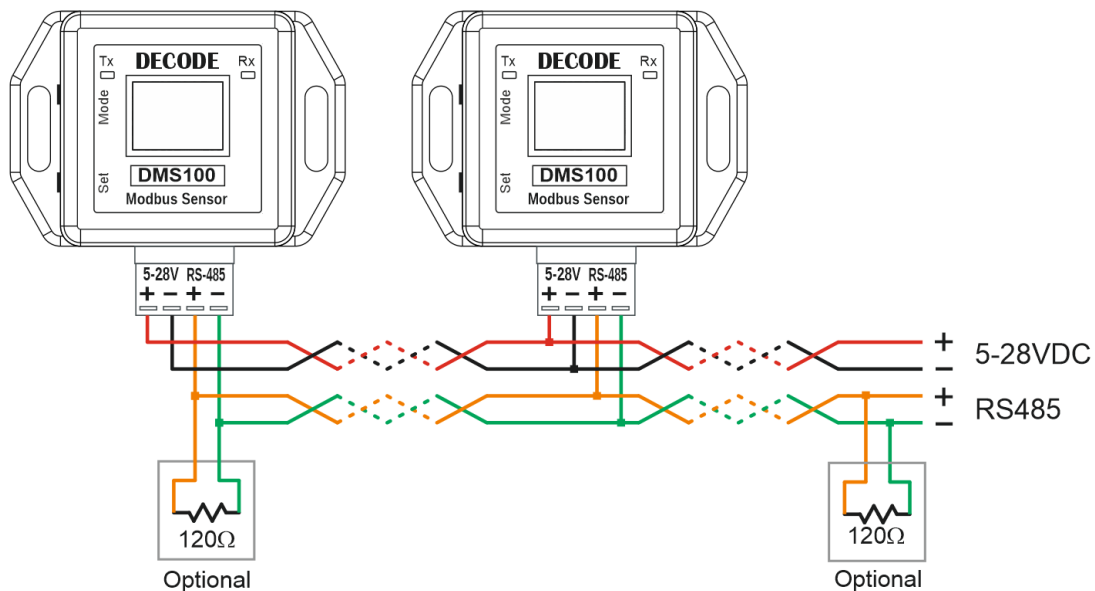
WARNING - Do not mount the product exposed to water and near supplementary heat sources, such as kitchen stoves, or in direct sunlight.



IMPORTANT - When perform enviroment measurements, to obtain stable measurement, make sure to mount the product at least 1.5 meters from the floor and at least 1 meter from the nearest radiator or door opening.

4 Wiring

Power supply and communication lines are connected to the detachable terminal block with wires of cross section up to 1.5mm². There are four terminals: (+) and (-) lines for 5-28V DC power supply, as well as (+) and (-) lines of the RS485 signal pair.



Picture 4: Wiring schematics

Power supply must be able to deliver at least 200mW for each DMS100 device on power supply line. For example, if ten DWS100 devices is supplied then minimal required power is $P_{\min} = 10 \times 200\text{mW} = 2\text{W}$. Also, voltage drop on long lines must be considered. For example, if 5V supply voltage is used to supply ten devices consuming 2W, then total current of 0.167A limits the maximum loop resistance to $R_{\max} = (5\text{V} - 4.5\text{V}) / 0.167\text{A} = 3\Omega$. If cable with 1.5mm² cross section and 11.5Ω/km is used, maximum cable length is $L_{\max} = 3\Omega / (2 \times 11.5\Omega/\text{km}) = 130\text{m}$. Multiplier two in equation is used to calculate resistance for both power supply wires.

For RS485 lines (+) and (-) notations is used for non-inverting and inverting signals. This notation avoid confusion with inconsistent B and A notation.



NOTE - For best performance twisted pair must be used for RS485 line.



NOTE - At the both ends of RS485 cable, line termination with 120Ω resistor is specified. At smaller distances, termination may be considered as option, but at distances greater than 100m and in conditions of major interference, line termination is required.

5 Functionality

5.1 Normal mode

After powering the unit, without pressing buttons, device enters NORMAL operating mode, read parameters from non-volatile memory, perform periodic measurements, display results and is ready for communication waiting for requests from master. LED indications signals the sending and receiving of data along the RS-485 line, red color for TX and green color for RX, Wrong polarity of RS-485 line is indicated by constantly lit RX. Factory default parameters are modbus address 1, serial speed 9600 bits per second and format 8 bit with "no parity".

In NORMAL mode all registers are read-only except Counter and OnTime registers on devices with switch input

5.2 Modbus setup mode

The MODBUS SETUP operating mode is used to perform modification of internal configurable parameters stored in non-volatile memory using Modbus communication. Values from non-volatile parameter memory are copied to registers 40009 to 40016 after power on. This mode is entered by holding both the SET and MODE button while powering on the device. Unit switches on, and after a while display shows "MODBUS SETUP MODE" message while LED RX and TX starts flashing in one-second cycle. When the buttons are released, LED indication and display returns to normal and device enter MODBUS SETUP operation mode with unlocked non-volatile memory.

In this mode, the serial speed, format and modbus address are automatically adjusted to 9600 bps, "no parity" and 1, regardless of the preset from non-volatile memory.

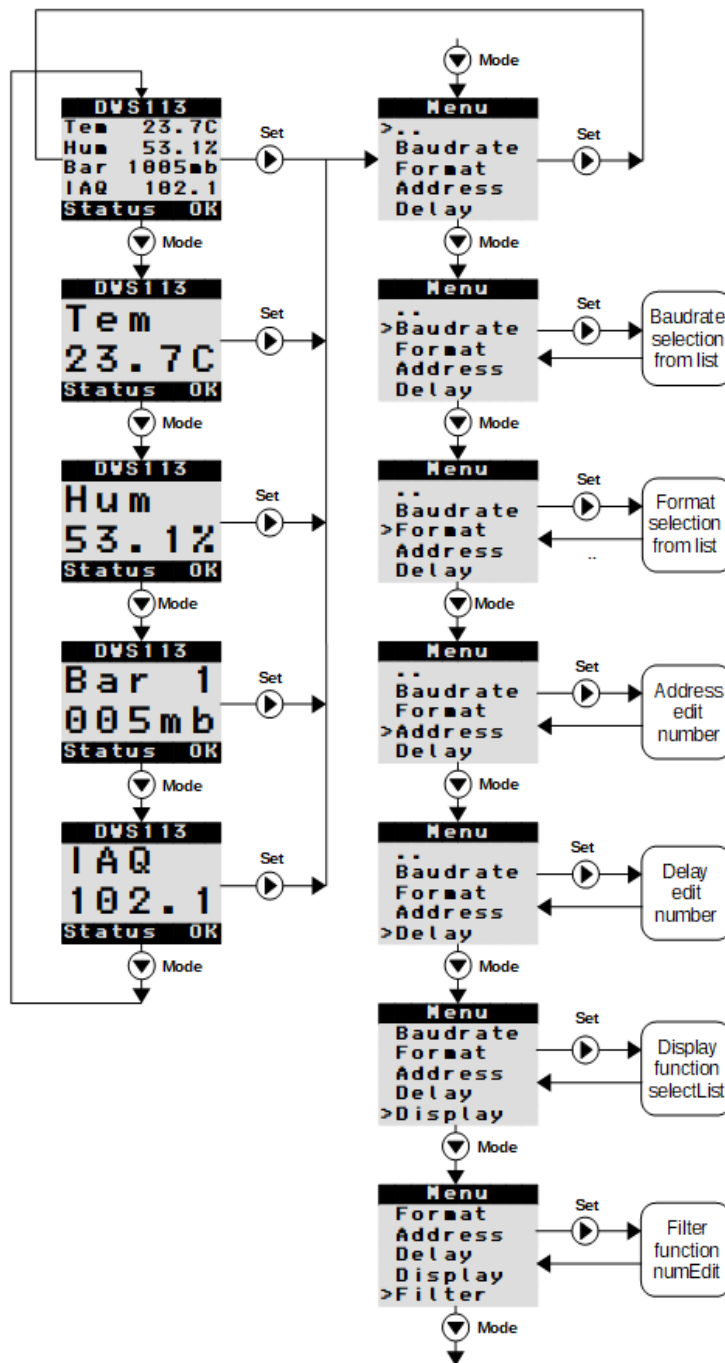
To modify values in registers 40009 to 40017, the modbus function 06 - Preset single register is used. Registers 40001 to 40008 remains as in NORMAL mode. Parameters like display mode, modbus address, serial speed and format settings are set in registers 40013, 40014, 40015 and 40016.

Storing the values from registers 40009 to 40016 to nonvolatile memory is performed by writing the value 11111 in special command register 40017. Register 40017 then automatically returns its value to 0 indicating command execution.

Exiting the MODBUS SETUP mode is only possible by powering the unit off and on without holding both buttons.

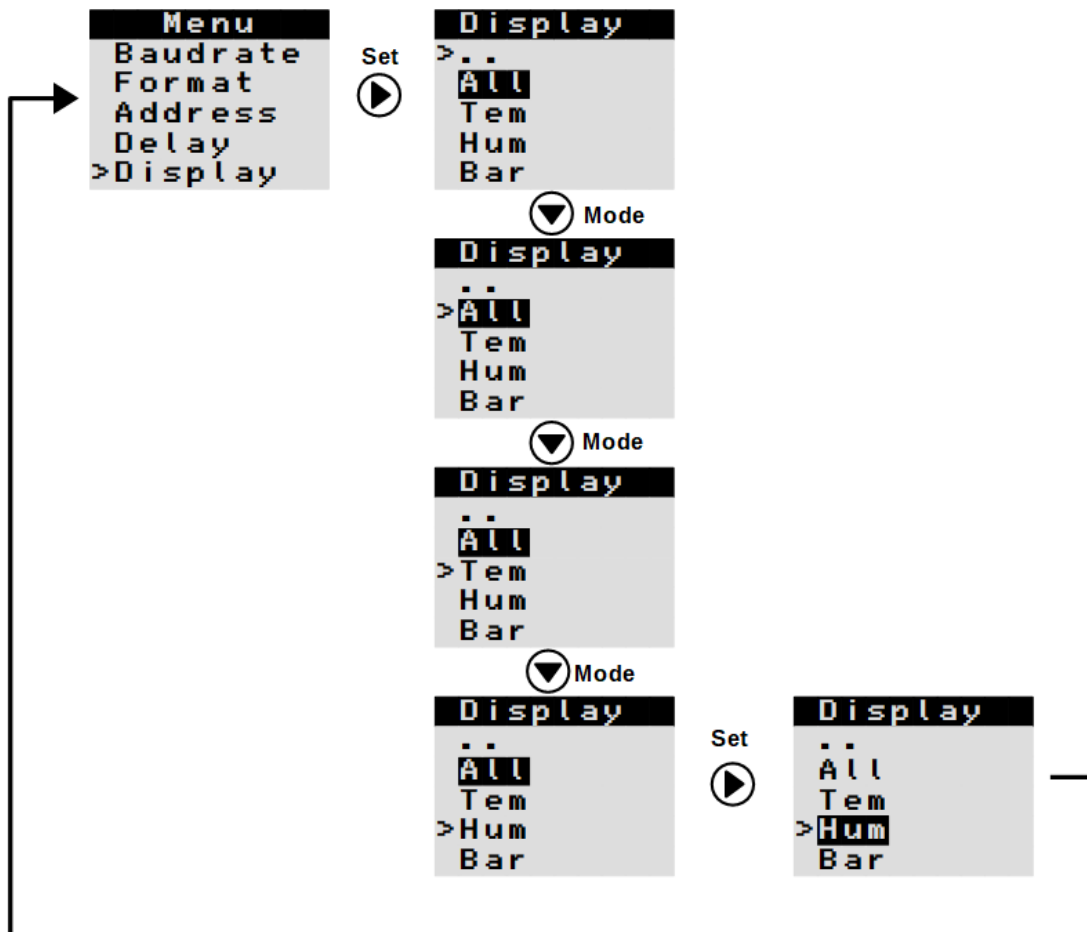
6 Display

OLED display, by default, shows measured values and can be used to configure device using two push buttons SET i MODE, positioned on the left side of the enclosure. Several display modes are present: 0 - Display All (default); 1 - Display value 1; 2 - Display value 2; 3 - Display value 3; 4 - Display value 4; and 5 - Scan modes 0 ~ 4.



Picture 5: Menu navigation

Menu navigation is performed using two buttons: SET and MODE. When device is in SCAN display mode, display modes are changed automatically without pressing MODE button. When SET button is pressed device enters MENU SETUP mode (not MODBUS SETUP) and device configuration is enabled using MENU interface. Configuration parameter are mostly selected from list but some of them need manual entry of numerical value.

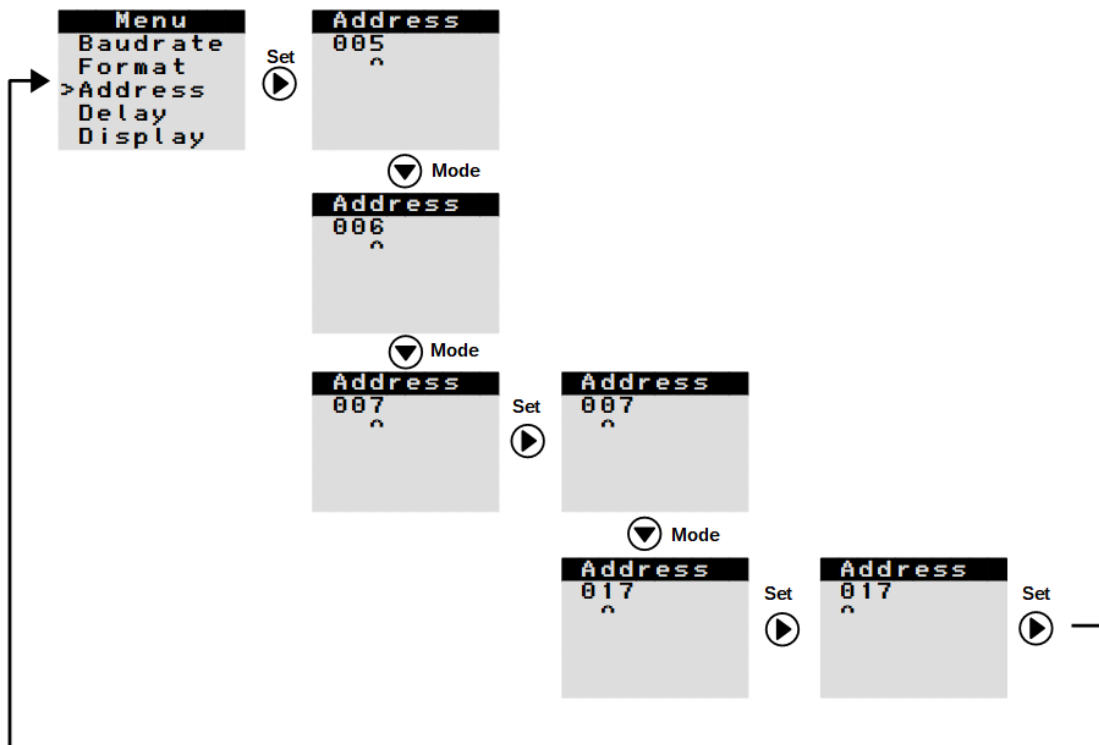


Picture 6: Selecting and changing parameter from list

When selecting parameter name from Menu by clicking SET button, parameter screen is shown, current value is displayed with inverted colors (white on black) and cursor position is marked with ">" sign. To return to Menu without changing move cursor to ".." and click SET button.

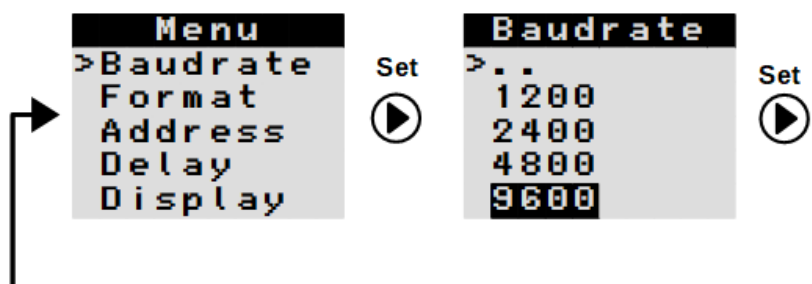
Generally, to select new parameter value from list, use MODE button for list scroll and SET button to select new value.

Numerical parameter values are entered from parameter screen by selecting digit position with SET button and scrolling and changing value from 0-9 with MODE button. To return from parameter screen to Menu screen without changing anything keep pressing SET button without pressing MODE button. After reaching last digit, click SET again to return to Menu.



Picture 7: Changing parameter using direct entry

To check current parameter value in list, click SET to enter parameter list and with second SET click return to Menu. Current value is shown with inverted colors (white on black).



Picture 8: Check parameter and return to Menu

7 Modbus communication

The Decode DMS100 device supports the Modbus RTU protocol on the RS-485 port. Supported serial speeds are 1200, 2400, 4800, 9600, 19200, 57600 and 115200 bits per second. Supported formats are 8 bit and No Parity, Even Parity or Odd Parity.

Device support two modbus functions: 03 - Read holding register and 06 - Preset single register. Preset function can be used only on holding registers described in section 7.1.2.

7.1 Supported functions

7.1.1 Function 03 - Read Holding Register

The query consists of 8 bytes. Pay attention that only existing registers can be read.

Byte	Field name	Content
1	Device address	x
2	Function	3
3	Register address Hi	x
4	Register address Low	x
5	Register number Hi	x
6	Register number Low	x
7	CRC error check Lo	x
8	CRC error check Hi	x

The response consists of n+5 bytes. For n from 2 to 34, length is from 7 to 39 bytes:

Byte	Field name	Content
1	Device address	x
2	Function	3
3	Bytes number	n
4	Register Hi	x
5	Register Low	x
...
n+4	CRC error check Lo	x
n+5	CRC error check Hi	x

7.1.2 Function 06 - Preset Single Register

The query consists of 8 bytes. This function can be used only in SETUP mode for holding registers from 40009 to 40017, and for holding registers from 40001 to 40003, on models with switch inputs.

Byte	Field name	Content
1	Device address	x
2	Function	6
3	Register address Hi	x
4	Register address Low	x
5	Register number Hi	x
6	Register number Low	x
7	CRC error check Lo	x
8	CRC error check Hi	x

The response consists of 8 bytes:

Byte	Field name	Content
1	Device address	x
2	Function	6
3	Register address Hi	x
4	Register address Low	x
5	Register number Hi	x
6	Register number Low	x
7	CRC error check Lo	x
8	CRC error check Hi	x

7.1.3 Function Error

In the event of an error, the following response is returned.

Byte	Field name	Content
1	Device address	x
2	Function	8
3	Error code	1, 2, 3 or 4
4	Register address Low	x
5	Register number Hi	x

Error code can have following values:

- 1 - Function code not supported
- 2 - Reading registers out of range (> 40017)
- 3 - Number of registers out of range (> 17)
- 4 - Function execution error

7.2 Internal Modbus memory map

The memory map supports 17 holding registers. The address is given in relation to the so-called "Base 0". Addresses referenced to "Base 1" are incremented by one.

Register	Address	Variables (see models for measured parameters)				
		Environment	Light	UV light	Switch	Color light
40001	0	Temperature	Intensity	UVA intensity	Counter_Lo	Red
40002	1	Humidity	0 - not in use	UVB intensity	Counter_Hi	Green
40003	2	Pressure	0 - not in use	0 - not in use	OnTime	Blue
40004	3	IAQ	0 - not in use	0 - not in use	0 - not in use	White
40005	4	Device Type - for example DMS112 reads 112, read only				
40006	5	Version - read only				
40007	6	DeviceID_Lo - unique identifier, low word, read only				
40008	7	DeviceID_Hi - unique identifier, high word, read only				
40009	8	0 - not in use				
40010	9	0 - not in use				
40011	10	0 - not in use				
40012	11	0 - not in use				
40013	12	Display mode (0, 1,..., 5) - see Display section for description				
40014	13	Modbus address (1-247)				
40015	14	Serial speed (0, 1,..., 5) 0 - 1200 1 - 2400 2 - 4800 3 - 9600 4 - 19200 5 - 38400 6 - 57600 7 - 115200				
40016	15	Serial format (0, 1, 2) 0 - No Parity 1 - Even Parity 2 - Odd Parity				
40017	16	Command for writing registers 40009 - 40016 to non-volatile memory. In MODBUS SETUP mode, writing 11111 starts the command and returns the register value to 0 after execution. In NORMAL mode, the value does not return to 0 and the command does not execute.				

8 Technical characteristics

8.1 Common characteristics of DMS100 series

Display	0.66" OLED, 64x48 pixels
Communication	Modbus slave, RS-485 bus, address range 1-247, broadcast address 0
Serial speed	1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 bps
Data format	1 start, 8 data, parity: None, Even, Odd
Factory defaults	9600bps, 1 start, 8 data, parity none, Modbus address 1
RS485 bus unit loading	Over 200 DMS100 devices connected on a single bus
RS485 bus I/O protection	> ±15 kV HBM Protection > ±12 kV IEC 61000-4-2 Contact Discharge > ±4 kV IEC 61000-4-4 Fast Transient Burst
Connection	Pluggable screw terminal block, 3.5mm pitch, wires up to 1.5mm ²
Power supply	4.5-28V DC, polarity and over-voltage protected, internally fused with 200mA fuse
Consumption	max. 200mW
Enclosure	ABS Plastic, wall, plate or pole mounting
Dimensions	50 x 35 x 20 mm
Protection	IP40

8.2 Model DMS101

Measured parameters	Temperature
Sensing element	NTC 10k inside enclosure
Sensor measurement range	-30 ~ 105°C
Resolution	0.1°C

8.3 Model DMS102

Measured parameters	Temperature
Sensing element	NTC 10k, 1m probe
Sensor measurement range	-30 ~ 105°C
Resolution	0.1°C

8.4 Model DMS110

Measured parameters	Temperature and humidity
Sensing element	Texas Instruments HDC2010
Sensor measurement range	Temperature: -40 ~ 125°C Humidity: 0 ~ 100.0%
Resolution	Temperature: 0.1°C Humidity: 0.1%

8.5 Model DMS111

Measured parameters	Temperature and barometric pressure
Sensing element	Bosch BMP280
Sensor measurement range	Temperature: -40 ~ 85°C Pressure: 300 ~ 1100hPa
Resolution	Temperature: 0.1°C Pressure: 1hPa

8.6 Model DMS112

Measured parameters	Temperature, humidity and barometric pressure
Sensing element	Bosch BME280
Sensor measurement range	Temperature: -40 ~ 85°C Humidity: 0 ~ 100% Pressure: 300 ~ 1100hPa
Resolution	Temperature: 0.1°C Humidity: 0.1% Pressure: 1hPa

8.7 Model DMS113

Measured parameters	Temperature, humidity, barometric pressure and AIQ
Sensing element	Bosch BME680
Sensor measurement range	Temperature: -40 ~ 85°C Humidity: 0 ~ 100% Pressure: 300 ~ 1100hPa IAQ: 0 ~ 500
Resolution	Temperature: 0.1°C Humidity: 0.1% Pressure: 1hPa IAQ: 1

8.8 Model DMS114

Measured parameters	Ambient light
Sensing element	Texas Instruments OPT3001
Sensor measurement range	1 ~ 65535 lux
Resolution	1 lux

8.9 Model DMS115

Measured parameters	Optical power (300 ~ 1000nm)
Sensing element	Texas Instruments OPT3002
Sensor measurement range	100nW/cm ² ~ 6.5535mW/cm ²
Resolution	100nW/cm ²

8.10 Model DMS116

Measured parameters	Red/Green/Blue/White light
Sensing element	Vishay VEML6040
Sensor measurement range	Red: Raw data 0 ~ 65535 counts Green: Raw data 0 ~ 65535 counts Blue: Raw data 0 ~ 65535 counts White: Raw data 0 ~ 65535 counts
Resolution	Red: 1 count Green: 1 count Blue: 1 count White: 1 count

8.11 Model DMS117

Measured parameters	UVA/UVB light
Sensing element	Vishay VEML6075
Sensor measurement range	UVA: 0.91 count/ $\mu\text{W}/\text{cm}^2$ UVB: 2.1 count/ $\mu\text{W}/\text{cm}^2$
Resolution	1 count

8.12 Model DMS130

Measured parameters	Switch input 1m cable
Sensing element	None, dry contact input
Output value	Counter: number of pulses 0 ~ $2^{32}-1$, 8Hz max. OnTime: time in on state 0 ~ 6553.5 seconds in 0.1s ticks

8.13 Model DMS131

Measured parameters	Alarm reed switch
Sensing element	Magnetic switch with reed contact
Sensor measurement range	Counter: number of pulses 0 ~ $2^{32}-1$, 8Hz max. OnTime: time in on state 0 ~ 6553.5 seconds in 0.1s ticks

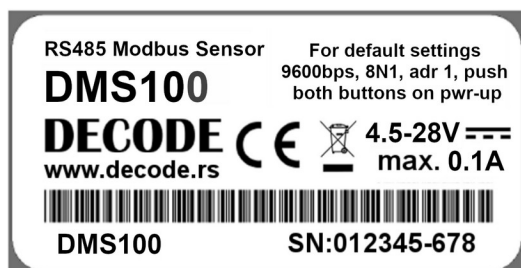
For detailed information about sensing elements please consult manufacturer documentation where it is applicable:

Texas Instruments <https://www.ti.com>

Vishay <https://www.vishay.com>

Bosch <https://www.bosch-sensortec.com/>

9 Product label



Picture 9: Product label

The label fixed on the bottom side of enclosure comprises information listed in next table.

Line 1	Product name	Additional information about product (optional)		
Line 2	Product model			
Line 3	Manufacturer	CE mark	Waste Disposal	Supply voltage
Line 4	Manufacturer address		Maximum current	
Line 5	Bar code with Product ID and Serial number			
Line 6	Product ID	Serial number		

10 Disposal and Recycling



You must dispose of this product properly according to local laws and regulations. Because this product contains electronic components, it must be disposed of separately from household waste. When this product reaches its end of life, contact local authorities to learn about disposal and recycling options, or simply drop it off at your local Decode office or return it to Decode.

11 Contact

Please contact a Decode office if you have any questions regarding the information contained in this manual or Decode products, or if you have any other inquiries.

Decode d.o.o.

Bulevar Nikole Tesle 30A

11080 Beograd, Srbija

Tel./Fax. +(381 11) 311 00 27

Email: office@decode.rs

Web: www.decode.rs