# MD150M
# Manual



## Panel meter for torque sensors with USB and RS485 interfaces

P.P.H. WObit E.K.J. Ober s.c.
Dęborzyce 16, 62-045 Pniewy
tel.48 61 22 27 422, fax.48 61 22 27 439
e-mail: wobit@wobit.com.pl
www.wobit.com.pl

# Content



Thank you for selecting our product!

This instruction will help you at correct service and accurate exploitation of described device.

Information included in this instruction were prepared with high attention by our specialists and is description of the product without any responsibilities within the meaning of the commercial law. Based on the information should not be inferred a certain features or suitability for a particular application. This information does not release the user from the obligation of own judgment and verification. P.P.H. WObit E.K.J. Ober S.C. reserves the right to make changes without prior notice.

- Please read instructions below carefully and adhere to its recommendation
- Please pay special attention to the following characters:

**CAUTION!**
Not adhere to instruction can cause damage or impede the use of hardware or software.

# 1. Safety and assembly rules

## Safety rules

- Prior to first start-up of the device carefully read the manual.
- Prior to first start-up of the device make sure all cables are properly connected.
- Provide appropriate working conditions, in compliance with the device specifications (e.g.: power supply voltage, temperature, maximum current consumption).
- Prior to any modifications of cables connections, disconnect power supply voltage.
- Dismantling of the indicator housing during guarantee agreement period results in its invalidation.

## Assembly recommendation

In the environments of unknown levels of interruptions it is recommended to use the following means preventing against possible interruptions of the device operation:

- Ground or zero the metal rails on which instruments are mounted.
- Do not power the device from the same lines as high power devices without appropriate network filters.
- Apply power supply, sensor and signal cables screening while screen grounding should be connected only on one side as close to the device as possible.
- Use communication cables (USB) equipped with filters in the form of ferrite beads.
- Avoid routing control (signal) cables in parallel with or in close vicinity of power and supply cables.
- Avoid close vicinity of devices generating high level of electromagnetic and/or pulse interference (high power loads, loads with phase or group power regulation).

# 2. Device description

## 2.1 Intended use and properties

**MD150M** panel meter is dedicated for torque sensors. Measurements can be made with resolution of 10 000 samples at rotational speed 0…5000 [rpm]. Due to programmed filtering and averaging of measured signals the measurement resolution can be increased.

MD150M has also **2 relay outputs**, which can be configured for switching on/off at specified thresholds and two inputs, which can be used for external triggering of measurement and for pause of current measurement.

MD150M is equipped with USB and RS485 MODBUS interfaces. USB interface allows recording measurement data in PC (e.g. to Excel file) with the use of MD150A-PC software. MODBUS-RTU allows reading of measurements from several indicators at the same time to PLC controller, HMI panel or its own PC application.

MD150M panel meter has full aluminium profile housing compliant with DIN43700 standard which guarantees high mechanical durability and resistance to adverse environmental conditions including electric interference.

**Features:**

- clear, 6 digits display
- torque measurement and conversion for appropriate units
- Signal filtering
- Maximal value memory
- USB connector for communication with PC
- RS485 MODBUS-RTU interface for industrial devices communication.

## 2.2 Theoretical information about NCTE torque sensors

Traditional methods of torque measurement usually use strain gauges with different methods of transition signals from rotational shaft to static parts of motor casing. In the simplest case it could be slip ring and electric brush. More advanced sensors use inductive or optoelectronic methods. It has fairy limitations, especially regarding maximal rotational speed, also it has shorter life time (in case of signals transition by brushes). Some sensors use acoustic wave (SAW) and there are also measuring methods with differential transformer. Defects of this kind solutions are mostly expensive and complicated construction and large size of the sensor.
Contactless torque sensors 2000 series use up-to-date FAST technology, which has not counted above defects. The main advantages of this technology are:

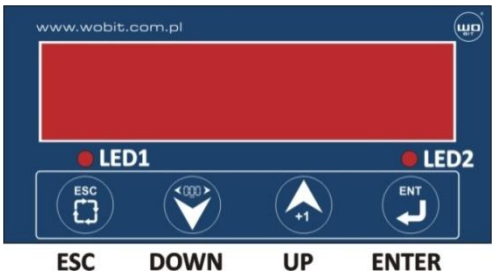
- Contactless measurement at velocity up to 10000 rpm
- No wearing, maintenance free,

- Resistance for vibrations, temperature, water,
- Bipolar measurements (range + and– with passage through 0),
- Small energy consumption.

The FAST method of torque and force measurement is based on the physical principle of Magnetostriction. Magnetostriction is defined as “any change of the dimensions of an object caused by a change of its magnetic state”. Ferromagnetic materials have the strongest magnetostrictive effect which was demonstrated for the first time by Joules in 1842 (length change of the iron wire during the process of magnetization).

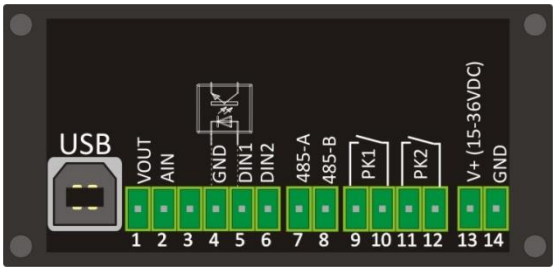
The **Joules effect**, concerning the change of the object caused by magnetization of a previously unmagnetized material, represents a direct magnetostrictive effect. In case of an already magnetized material there can be observed a change of the magnetic field in the object which exhibits changes of its mechanical characteristics, known as inverse magnetostrictive effect. The most familiar magnetostrictive effect is probably the **Villari effect**: Villari demonstrated that changes of the magnetic field in a ferromagnetic object occur under application of stress / force on the object.

## 2.3 Description of interfaces and front panel




| | |
|---|---|
| **LED1** | - indicator of PK1 relay activation |
| **LED2** | - indicator of PK2 relay activation |
| **ESC** | - abortion, Reset |
| **DOWN** | - next menu position/next parameter digit |
| **UP** | - previous menu position / digit value increase |
| **ENTER** | - menu entry/confirmation of entered changes |

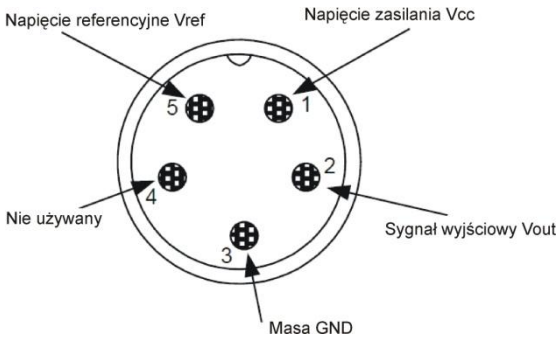
Rear panel



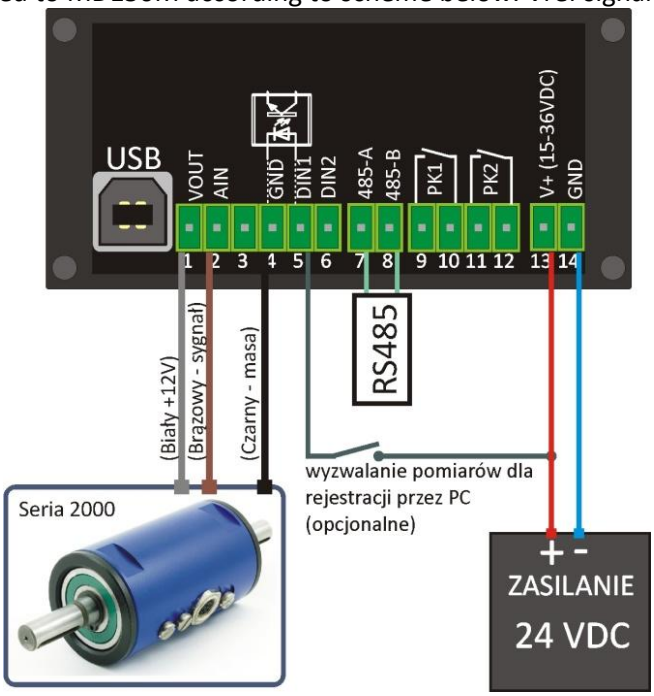

| | | |
|---|---|---|
| 1 | VOUT | 12VDC output, max. 200mA |
| 2 | AIN | Analogue input 0-10V / 0 -20mA |
| 4 | GND | Mass |
| 5 | DIN1 | Digital input (5-24V)of measurement triggering |
| 6 | DIN2 | Digital input (5-24V) of current value withholding |
| 7 | 485A | Signal A of RS485 interface |
| 8 | 485B | Signal B of RS485 interface |
| 9,10 | PK1 | PK1 (NO) relay contacts |
| 11,12 | PK2 | PK2 (NO) relay contacts |
| 13 | V+ | 12-36 VDC power supply, min. 250mA |
| 14 | GND | Power supply mass |

## 2.3 Connections diagram

To connect sensor 2000 series should be used dedicated cable. Cable color description and cable meaning is shown on picture below.

| Description of sensor connector 2000 series | Cable color description | |
|---|---|---|
|  | PIN nr | Cable type 3 |
| | 1 - VCC | white |
| | 2 - Vout | brown |
| | 3 - GND | black |
| | 4 - NC | blue |
| | 5 - Vref | gray |

Sensor should be connected to MD150M according to scheme below. Vref signal is not used.




*Picture. 1 Example of sensor connections to MD150M panel meter.*

# 3. Menu description

## 3.1 MENU map

| | | | | |
|---|---|---|---|---|
| *000000* -> Displaying of current measurement value | | | | |
| Menu entry | | Min. measurement value display | Max. measurement value display | (3 sec.) Reset of min/max measurement value |
| *1. P1* -> Menu | | | | |
| Next/previous parameter | | Parameter selection | | Digit selection<br>Change value<br>Parameter edition |
| 1. | P1 | PK1 relay threshold | Relays | ± 999999 |
| 2. | P2 | PK2 relay threshold | Relays | ± 999999 |
| 3. | P3H | Relays switching on/off hysteresis | Relays | ± 999999 |
| 4. | MODE | Relays operational mode | Relays | 0 / 1 / 2 |
| 5. | SENS | Measurement input mode | Measurement | 1…999 [mV/nM] |
| 6. | CALIB | Minimum signal from sensor | Measurement | - |
| 7. | UNIT | Maximum signal from sensor | Measurement | 1 – Nm, 2 - Ncm |
| 8. | DECP | Minimum displayed value | Measurement | 0..2 |
| 9. | ABS | Maximum displayed value | Measurement | ON / OFF |
| 10. | FILT | Filtration level | Measurement | 0-99 |
| 11. | ADR | Number of decimals of the result | RS485 | 0-99 |
| 12. | BAUD | MODBUS address | RS485 | 19200 / 38400<br>57600 / 115200 |
| 13. | BEP | MODBUS transmission speed | Others | ON/OFF |
| 14. | LED | Keys audible signal | Others | 0-9 |
| 15. | FAC | Display brightness level | Others | - |
| 16. | PAS | Restoring factory default settings | Others | X-0000 – non active |
| Menu exit/abortion | | Parameter confirmation/abortion | | |

- Blinking measurement value preceded by C symbol on the display means the result overflow (the result is not contained within 6 positions of the display). In order to display older part of the result, press .
- Exceeding of measurement range (10V or 20mA) results in blinking of the displayed value

## 3.2 Example of parameter change

After correct connection of external elements and switching power supply on, MD150M process display is ready for operation with previously used settings, and in case of first operation – with factory settings.

- In order to enter programming mode, press . The display shows ***1. P1***, if the password is switched off or ***0000,*** if it is active. In such case, in order to enter programming mode (at active password) enter the password and confirm it with the key ;
- With subsequent pressing of key you switch to next parameters and with pressing of key you return to previous parameters.
- At the selected parameter you want to change, press ;
- With key select display digit position you want to change and change its value with key . Confirm the entered value with key ;
- Value of single digit parameters is selected with keys and ;
- If you want to enter a negative value select the first digit (from the left) then press and hold key until the symbol "-" is displayed.
- With key you confirm the introduced change and with key you abort the change or exit the menu.

Prolonged pressing of keys or results in automatic increase/decrease of a given position/value.

# 4 Configuration of measurements

## 4.1 Torque sensor configuration

***5.SENS*** **-Sensor calibration constant**
For correct reading of torque should be entered calibration constant of used sensor. This value can be found on sensor label.


Readied value should be enter to ***5.SENS*** parameter.

***6.CALIB*** - **Zero calibration**
If panel meter indicates no zero value at zero torque, function of zero calibration should be executed. Calibration value is recorded in non-volatile memory until next calibration or until restoration of factory presets.
Zero calibration is recommended after connection of sensor to the final machine. Calibration execution at overload sensor can cause appearing of ***RANGE*** message – therefore zero calibration won't be executed.

## 4.2 Measurements configuration

***7.UNIT*** – selecting of measurement unit in Nm or Ncm

***8.DECP*** – parameter specifies the number of decimals of displayed value. If DECP is set to 0, panel meter displays only the Total measurement part. For DP = 4 the result includes four decimal places.

Parameter DECP also influences the range of values of entered parameter ***P1***, ***P2***, ***P3-H***. If ***DECP*** = 0, then settings ***P1***, ***P2***, ***P3-H*** can be changed only in total part in the range of -99999 up to 999999.

***7.ABS*** – activation of absolute value. When parameter is set on ON, panel meter always show positive value no matter of direction of the torque, which influence on sensor.

## 4.3 Filtering of measurements

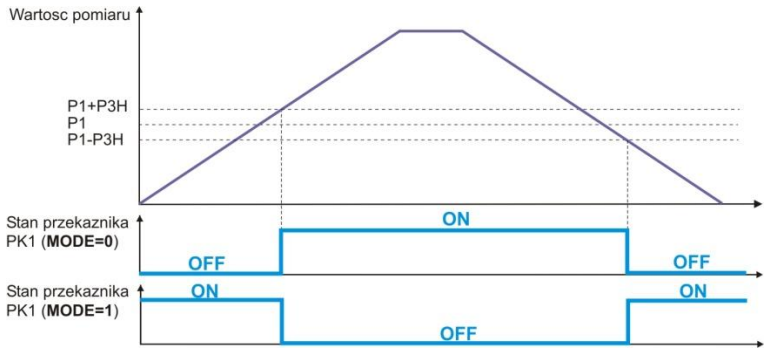
Parameter ***8.FILT*** specifies filtration level. The higher the filtration value (max. 99), the more stabile indications, however, response to changes of the measured signal is slower. For example, for set filtration equal to 99 and change of input signal from 0V -> 10V, the indicator reaches indicated value 10V after 1 sec. (100Hz/99 ->"1).

# 5 Configuration of relay output

MD150M panel meter has 2 relay outputs PK1 and PK2 which can be switched on/off depending on current measurement value. The following parameters are used for relay outputs configuration:

***1. P1*** - activation (deactivation) threshold of PK1 relay
***2. P2*** - activation (deactivation) threshold of PK2 relay
***3. P3H*** - hysteresis level of activation/deactivation of PK1 and PK2 outputs
***4. MODE*** - output operating mode:

**Mode 0** – Absolute with two thresholds. Activation of PK1 and PK2 outputs is made after reaching of P1 and P2 values, respectively.
**Mode 1** – Reverse with two thresholds. Operation is similar to the above mode. Deactivation of PK1 and PK2 outputs is made after reaching of P1 and P2 values, respectively.

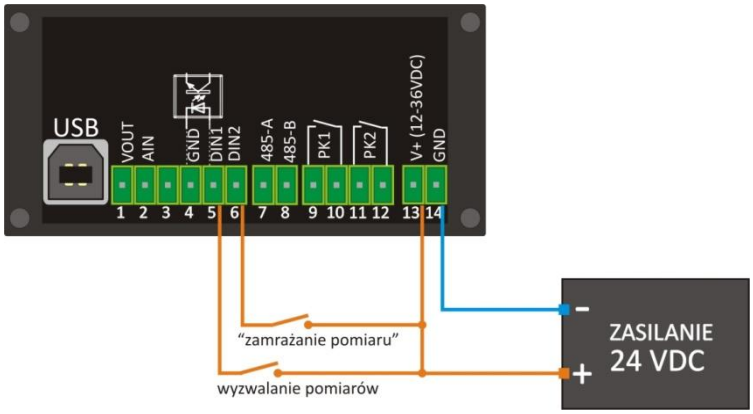



*Picture. 2 Example of PK1 relay output activation depending on P1 and P3H setting **and operating mode** (MODE).*

# 6 Digital input DIN1, DIN2

**DIN1** input enables interception of measurements by MD150M-PC software. In order to activate the function, you should check the option “DIN1 triggering” in the software.
Automatic data acquisition is stopped at this moment. The next measurement shall be intercepted by software only at the moment of increasing slope at DIN1 input, i.e. change of the signal status from 0V to +5..+24V.

**DIN2** input is used for “freezing” of a current measurement on the MD150M panel meter display. The last measured value is displayed (blinks) until DIN2 input reaches high status (+5...+24V).



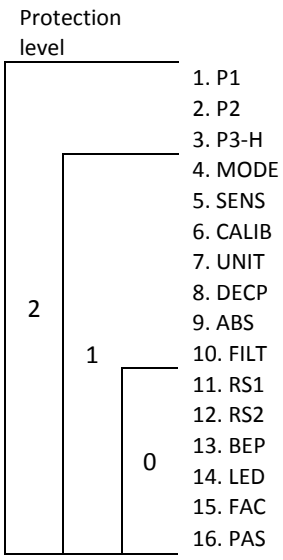

Picture. 3 *Example of DIN1 and DIN2 outputs control.*

# 7 Password protection

Access to the process display settings can be password protected (parameter 16. PAS). There are 3 protection levels available. Protection level is set with the first digit, and the last 4 digits are used for password entry.

| ***0-0000*** | |
|---|---|
| | 4-digits password (0-9999) |
| | Protection level:<br>**0**-Settings protection above FILT parameter<br>**1**-Settings protection above P3-H parameter<br>**2**-Protection for all settings |

If the digital processing unit is password protected, then after switching to protected settings the display shows ***0000*** value – enter previously set password.
The password can be deactivated by switching the parameter **16. PAS** and setting 0000 value.



# 8 USB and RS485 MODBUS interface

## 8.1 USB interface

USB interface is used for communication of MD150M process display with MD150-PC software (device configuration, recording of measurements) and for updating of internal software. MD150M process display must be powered in order to facilitate communication via USB.

**CAUTION**

USB interface is prone to interference in the power supply grid and to electromagnetic interference occurring in industrial environments. In case of connection problems during communication of the digital processing unit with MD150M-PC software, apply additional protective elements in the form of:

· Powering of MD150M digital processing unit from an independent power supply source,
· Application of network filters upstream of the indicator supply feeder.
· Use of USB cable of length <1,5m equipped with ferrite beads at the cable beginning and its end.
· Use of optically insulated USB hubs at PC side.

In the conditions of severe interference (e.g. high interference of power grid) the communication may not be possible..

## 8.2 RS485 interface (MODBUS-RTU)

MD150M panel meter is equipped with RS485 interface. It can be used for communication with PLC controller, HMI panel or other device supporting MODBUS-RTU protocol. Default transmission parameters:

- Baud rate: **38400bps**, Bits: 8, Stop Bits: 1, Parity: none
- Address **Modbus: 1**

Modbus address and baud rate of MD150M can be set with the following parameters:

**12. ADR** - MODBUS speed setting(9600, 19200, 38400, 57600, 115200)
**13. BAUD** - MODBUS address setting (1…99)

### 8.2.1 Description of MODBUS protocol

**Implemented functions MODBUS**

| Function nr (hex) | Description |
|---|---|
| 1 (0x01) | Reading of output status (relays) |
| 2 (0x02) | Reading of input status (DIN1, DIN2) |
| 3 (0x03) | Reading of X registers |
| 5 (0x05) | Recording of single Bit |

### Map of MD150M register addressing

| Address (dec) | Type of variable | Type of data | Function (dec) | Description |
|---|---|---|---|---|
| 0 (*1) | MES_INT | INT | 3 | Value of measurement (only total part) |
| 1 (*2) | MES_MIN_INT | INT | 3 | Registered minima value (only total part) |
| 2 (*3) | MES_MAX_INT | INT | 3 | Registered maximal value (only total part) |
| 3-4 (*4-5) | MES_REAL | REAL | 3 | Value of measurement |
| 5-6 (*6-7) | MES_MIN_REAL | REAL | 3 | Registered minima value |
| 7-8 (*8-9) | MES_MAX_REAL | REAL | 3 | Registered Maxima value |
| 5000 (*5001) | MIN_MAX_RESET | BIT | 5 | Reset of registered value min/max |
| 5002 (*5003) | INPUT | BIT | 2 | Reading of input status DIN1/DIN2 |
| 5004 (*5005) | OUTPUT | BIT | 1 | Reading of output status PK1/PK2 |

* for devices with address starting with 1 value(offset address +1)

CAUTION: 4-Byte number of type REAL is contained in two registries. The first registry contains younger part of the number, the second - its older part. In order to read REAL number value correctly, read registries of number 2 and 3 and then conduct appropriate conversion.

Conversion of 2 registries (4 Byte) into 32 Bit number REAL

Register HI <-> Bajt1
Register _X LO <-> Bajt0
Register X+1 HI <-> Bajt3
Register _X+1 LO <-> Bajt2

**Number _32_bit** = **Byte3**<<24 + **Byte2**<<16 + **Byte1**<<8 + **Byte0**
Or number_32_bit = Registry_2 + Registry_3<<16

# 9 Technical parameters

| Description | Parameter |
|---|---|
| Power supply | 15 … 36 VDC, recommended 24 VDC, min. 250mA |
| Sensor supply output | 12VDC, max load. 200mA |
| Measurement input | 0…5V, Resolution ±1mV<br>Non-linearity error: 0,05% FSR<br>Temperature error: 0,003%FSR/1°C<br>Max. measurement frequency:: 100Hz |
| Digital inputs DIN1, DIN2 | Low status 0V (max. 2V), high status +24V (5…24V) |
| Relay outputs PK1, PK2 | 2 x 1A/125VAC, 2A/30VDC |
| Communication | RS485 MODBUS-RTU**,** default parameters 38400, 8:n:1,<br>USB: 1.1, 2.0 |
| Operating temperature range | 0..50$^{o}$C |
| Display | 6 digits, height 13.5 mm |
| Casing | Height: 45 mm<br>Width: 92 mm<br>Length: 81 mm |
| Weight | 200 g |
| IP protection | IP40, from front panel – IP65 |
| Universal password | 3145 |